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## ABSTRACT

This instructor's manual contains information and activities related to human growth processes. The curriculum focuses on choices students can make for a healthy lifestyle and is based on the most up-to-date research about human growth and development. Students generate and test their hypotheses throughout each of five modules which include Anthropometry (skeletal measurement and growth), Bone Chemistry and Composition, Nutrition, Exercise Physiology, and Genetics. The modules include hands-on activities for grades 5-9 and can be taught independently or in conjunction with an established curriculum. Teacher information sheets and assessment ideas are also presented. The Human Growth curriculum requires students to integrate skills in science, mathematics, health, reading, and writing. Throughout the modules, activities such as data collection, graphing, measurement, general scientific inquiry, and composition of lab reports based on student-generated data are used to help students engage in solving various problems. Students can work individually, in small groups, or as a class during the various activities. An accompanying CD-ROM contains information and activities related to human growth processes. (WRM)

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## GUIDE TO A

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# Instructor's Manual

# **HUMAN GROWTH: GUIDE TO A HEALTHIER YOU**

**A Middle School Science Curriculum**

## **INSTRUCTOR'S MANUAL**

**prepared under USDHHS/NIH Grant #R25 RR07675**

**The Ohio State University  
Columbus, Ohio**

**January 1996**

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**I HEAR, AND I FORGET  
I SEE, AND I REMEMBER  
I DO, AND I UNDERSTAND**

**–Chinese Proverb**

# HUMAN GROWTH: GUIDE TO A HEALTHIER YOU

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## Beneficial Activities Explored Within Modules

	Anthropometry	Bones	Nutrition	Exercise	Genetics
	1	2	3	4	5
Observing	•	•	•	•	•
Classifying	•	•	•		•
Comparing	•	•	•	•	•
Measuring	•	•	•	•	•
Communicating	•	•	•	•	•
Organizing Data	•	•	•	•	•
Recording Data	•	•	•	•	•
Interpreting Data	•	•	•	•	•
Inferring	•	•		•	•
Predicting	•	•	•		•
Using Numbers	•	•	•	•	•
Replicating Procedures	•	•	•	•	•
Decision Making		•	•	•	•
Controlling Variables	•		•	•	•
Formulating Hypotheses	•	•	•	•	•



## CURRICULUM OVERVIEW

This newly created curriculum focuses on the student's choice of healthy lifestyles, using the most up-to-date research about human growth and development. Students generate and test their own hypotheses throughout each of the five modules: anthropometry (skeletal measurement and growth); bone chemistry and composition; nutrition; exercise physiology; and genetics. These modules include hands-on activities for grades five through nine and have been designed to be taught independently or in conjunction with an established curriculum.

The ultimate goal of this course of study is to empower students to make informed decisions leading to their good health. The activities also encourage students to develop 1) an interest in science, and 2) an awareness of science-related careers.

This curriculum requires the students to integrate skills in math, science, health, reading, and writing. Throughout the modules, data collection, graphing, measurement, scientific inquiry, and composition of lab reports based on student generated data are used to help them apply valuable problem solving strategies. Students work individually, in small groups, and as a class to communicate their ideas and draw conclusions about their research.

This project has been supported by the National Institutes of Health and is available from the Eisenhower National Clearinghouse (1-800-276-0462).

## ROLE OF THE TEACHER

In this curriculum, the teacher functions as a facilitator of student interaction, a director of research, a resource person, and a guide to the student in making healthy lifestyle choices. The role of the teacher is not passive. The instructor seeks to help the student convert theory into practice by assisting young people in making informed healthy choices.

Teachers from a variety of grade levels have assembled these lessons, and have made them as user-friendly as possible. The authors have provided background material for topics that are technical or unfamiliar. Both experienced and novice teachers will find that reading the entire lesson, studying the applicable lab sheets, and considering the needed materials is all the preparation required to be successful with these activities. These modules have been designed to be used independently or in conjunction with an established curriculum. They can be an excellent supplement to text material or enhance current interactive programs.

It is the sincere hope of the teachers who wrote, field-tested, and revised these lessons that our colleagues will find the activities challenging and beneficial for their students, as they seek to help young people develop healthy lifestyles.

## *SAMPLE LETTER TO PARENTS*

Dear Parent or Guardian,

Your child is about to embark on an exciting new curriculum which is the product of a grant from the National Institute of Health called the Science Education Partnership Award. It is the educational component of a clinical study on calcium conducted at The Ohio State University.

The purpose of this curriculum is to promote a healthy lifestyle both during the student's adolescent growth period and throughout his or her life. Your involvement and interest will enhance your child's learning and application of positive lifestyle choices.

These lessons were written by classroom teachers and are student-centered. Participants engage in research and data gathering through hands-on activities designed to interest young people. Many activities ask students to gather data on themselves and apply it to current research on growth.

"Human Growth: Guide to a Healthier You" contains five modules. Your student may be using all or part of this curriculum during the school year. The areas of study are Anthropometry (skeletal measurement), Bone Chemistry, Nutrition, Exercise Physiology and Genetics.

These lessons ask students to integrate skills in math, science, health, reading and writing. Throughout the modules, data collection, graphing, measurement, scientific inquiry and composition of lab reports based on students' findings are used to help learners apply valuable problem solving strategies. Students work in a variety of small groups and individually, communicating their ideas and drawing conclusions from their testing and research.

Thank you in advance for your support and cooperation. If you have any expertise that you would like to share as we work on these concepts, please contact me.

## MASTER EDUCATIONAL MATERIALS LIST

### REQUIRED:

All Lab Sheets A-1A through G-6B (included with curriculum)

8 1/2 X 11" plain white paper for sketches

acetone

balance scale

calculators

chicken bones (preferably leg or thigh bone), cooked

chicken or turkey skeletons, prepared by the instructor

cow femurs

construction paper

diluted hydrochloric acid (HCL

disposable gloves

dissection kit (forceps, scissors, knife, and dissecting probe)

dropper bottles

food labels with serving sizes (students may bring these from home)

Food Models, National Dairy Council, 1990; **strongly recommended**; ISBN 1-5564-7042-6;

(an option is to make your own)

fresh egg white or powdered albumin

glue

graduated cylinder

graph paper

Guide to Good Eating, National Dairy Council, 1989; ISBN 1-5564-7001-0

household ammonia

interstitial fluids (bloody juice from fresh meat)

magnifiers

metric measuring tape

metronome or watch with a "second" hand

microscope or bioscope

microscopic slides, cover slips, lens paper, and medicine droppers

newspapers to cover tables

overhead projector

owl pellets

paper towels

pencils or markers, colored

plastic bags for waste removal

plastic wrap

poster board

pull-up bar

raw eggs

red and yellow food coloring

refractometer or hydrometer

rubber bands

## MASTER EDUCATIONAL MATERIALS LIST, CONTINUED

ruler with English measurement  
simulated urine samples with abnormally high levels of ketone, sugar, pH, and specific gravity (purchased by the school or prepared by the teacher)  
skinfold calipers  
sphygmomanometer (blood pressure cuff)  
step or chair  
stopwatch or clock with second hand  
table salt  
transparencies  
transparent 500 ml containers (jars)  
tweezers or forceps  
urinary test strips (e.g. Chemstrips 6 or 7, Labstix 5, or Multistix 7) which include tests for at least glucose, ketone, pH, protein, and occult blood  
variety of foods (e.g. cereal, potato chips, vegetables, peanut butter, juices, bread)  
variety of media portraying body images over time (possible sources: back issues of fashion magazines such as Life, Vogue, Ladies' Home Journal, etc., art history books, old photographs, and history books)  
water-based marker  
white vinegar

# MODULE 1: ANTHROPOMETRY

Anthropometry is the science that deals with the measurement of size, weight, and proportion of the human body.

In this module the Student will:

Lesson One:

- (a) Make estimations of individual growth.
- (b) Make accurate measurements of body parts in centimeters.
- (c) Identify similarities in given body measurements.

Lesson Two:

- (d) Construct a bar graph of group height measurements.
- (e) Determine average class heights for males and females.
- (f) Compare and contrast average class height for males and females with national norms.

Lesson Three:

- (g) Demonstrate an understanding of the importance of percent body fat.
- (h) Determine his/her percent body fat from a standardized table.

Lesson Four:

- (i) Learn to use a skinfold caliper properly to determine percent body fat using one or more skinfold measurements.
- (j) Determine where he/she is in relationship to national norms for mid-arm circumference and tricep skinfold thickness.
- (k) Demonstrate an understanding of the differences between percent body fat and percentile on national norm charts.

NOTE TO TEACHER:

Appendix F contains additional student assessment activities for both individuals and small groups. These activities stress problem-solving skills and encourage creativity among the students.

## LESSON ONE: "How Do I Measure Up?"

**TIME:** two 45-minute classes



**OBJECTIVES:** The Student will:

1. Make estimations/predictions of individual growth;
2. Take accurate measurements of selected body parts in centimeters; and
3. Identify similarities or patterns in selected body measurements.

### VOCABULARY:

circumference: distance around

hand span: wrist crease to finger tip

hand spread: the greatest distance you can obtain by spreading your hand on the table and measuring from thumb to tip of little finger

length of reach: measurement from fingertip to fingertip when arms are spread out to the sides (equal to approximate height measurement)

long "cubit": distance from tip of elbow to the tip of finger

short "cubit": distance from tip of elbow to knuckle of clenched fist

### MATERIALS AND EQUIPMENT:

Lab Sheets A-1A

stadiometer or wall tape

metric measuring tape or A-1C

graph paper

Optional:

Lab Sheets A-1B

Lab Sheet A-1D.

### PREPARATION:

1. Place tape measures and/or stadiometer for measuring height at two or more locations.
2. Duplicate Lab Sheet A-1A, one per student.
3. If needed, duplicate tape measure pattern A-1C.

Optional:

4. Duplicate Lab Sheets A-1B and A-1D.

### PROCEDURE:

1. Explain measurement procedure and discuss metric system as needed.
2. Distribute Lab Sheets A-1A.
3. Pose question, "Which body measurements will be similar?"
4. Divide class into small groups.
5. Complete Lab Sheet A-1A. Teacher should circulate around the room, and observe students recording measurements. Note to teacher: The measurements

- generally will increase as you proceed down the page of body regions.
6. Graph data. Suggestions: hand spread; estimation vs. actual; individual body measurements in order.
  7. Suggested discussion questions:
    - (a) Were your estimations accurate?
    - (b) Are there any noticeable patterns between the measurements of different body regions?
    - (c) Which body measurements are nearly the same?
  8. Collect and store Lab Sheets A-1A.
- Optional:
9. Distribute Lab Sheets A-1B or A-1D as homework. Have students construct a line graph showing the trends in collected data.

**Spring:**

10. Pose question: "Which body measurements have changed the most since Fall?"
11. Distribute Lab Sheets A-1A.
12. Make and record Spring estimations.
13. Measure and record Spring measurements.
14. Suggested discussion questions:
  - (a) Which body measurements have changed the most?
  - (b) Were your estimations accurate? If not, how could you have made more accurate predictions?

**EVALUATION:**

1. Did the students' answers increase as they proceeded down the page?
  2. Were students' estimations reasonably accurate?
  3. Were students able to identify similar body proportions?
  4. Completion of Lab Sheets A-1A.
- Optional:
5. Completion of Lab Sheets A-1B or A-1D and line graph.

**RESOURCES:**

1. Allison L, Blood and Guts: a Working Guide to Your Insides, Brown Paper School Book, NY, 1976. ISBN 0-3160-3443-6.
2. Broekel R, Your Skeleton and Skin: A New True Book, Childrens Press, Chicago, 1984. ISBN 0-5160-1934-1.
3. Richardson J, Science Dictionary of the Human Body, Troll Associates, Mahwah, NJ, 1992. ISBN 0-8167-2442-3.

NAME: \_\_\_\_\_

# HOW DO I MEASURE UP?

## Metric Practice

\* Denotes an optional measurement

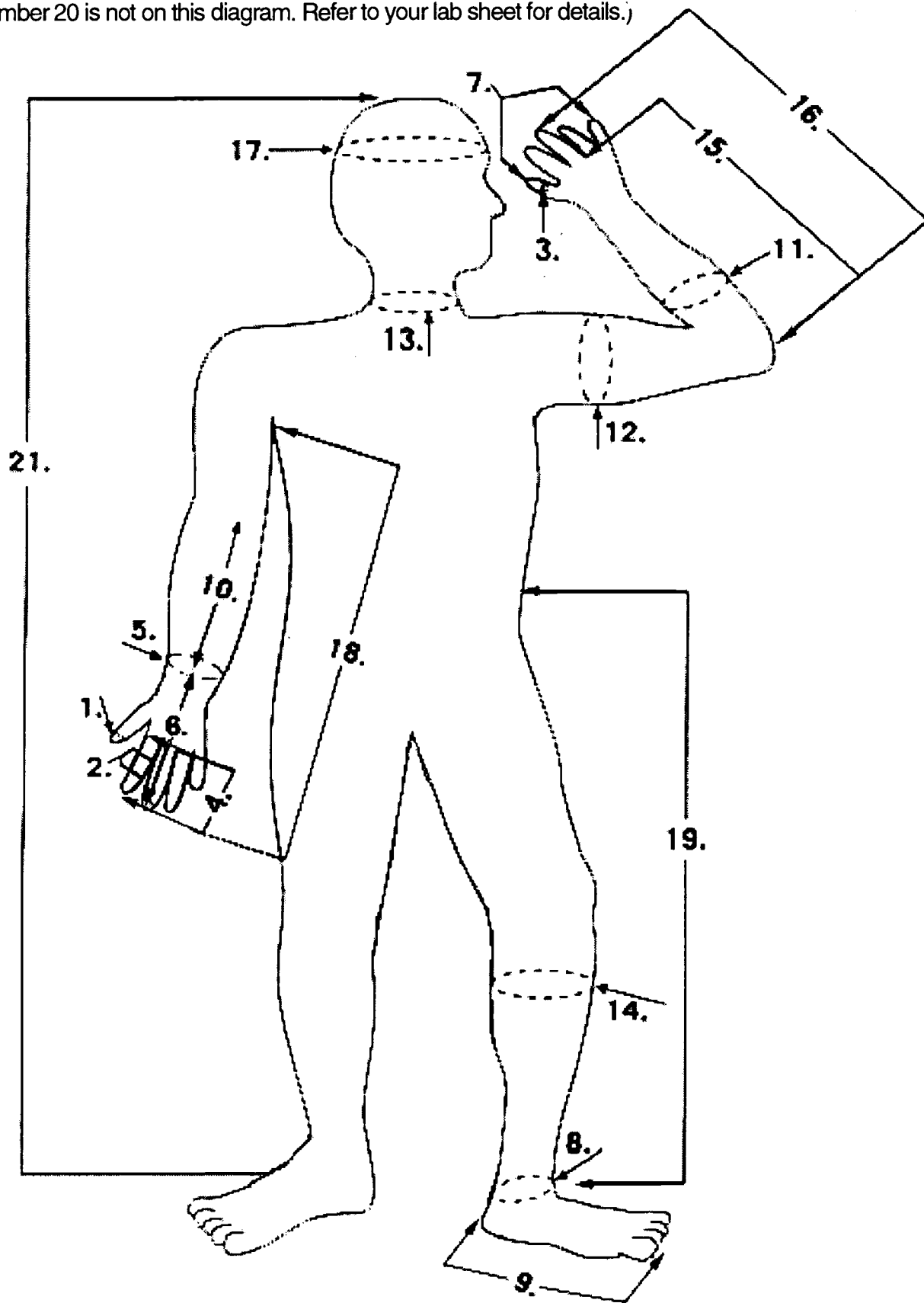
Measurements to be taken in cm

	FALL est. measure	SPRING est. measure
1. Width of thumb nail		
2. Length of mid-digit of index finger		
3. Circumference (distance around) of thumb knuckle		
4. Length of index finger (from crease)		
5. Circumference of wrist		
6. Hand span (wrist crease to finger tip)		
7. Hand spread (the greatest distance you can obtain by spreading your hand on the table and measuring from thumb to tip of little finger)		
*8. Circumference of ankle (smallest part)		
9. Length of foot (standing with shoe off)		
10. Distance from wrist to crease inside of arm (near elbow)		
11. Circumference of forearm		
*12. Circumference of biceps (flexed)		
*13. Circumference of neck		
*14. Circumference of calf muscle (flexed)		
15. Short "cubit" (distance from tip of elbow to knuckle of clenched fist)		
16. Long "cubit" (distance from tip of elbow to the tip of finger)		
17. Circumference of head (taken just above ears and eyebrows)		
18. Length of arm (under arm to finger tip)		
19. Outside leg length (natural waistline to sole of foot)		
20. Length of reach (measure from fingertip to fingertip when arms are spread out to the sides)		
21. Your height (without shoes)		



# Diagram of Body Regions to be Measured

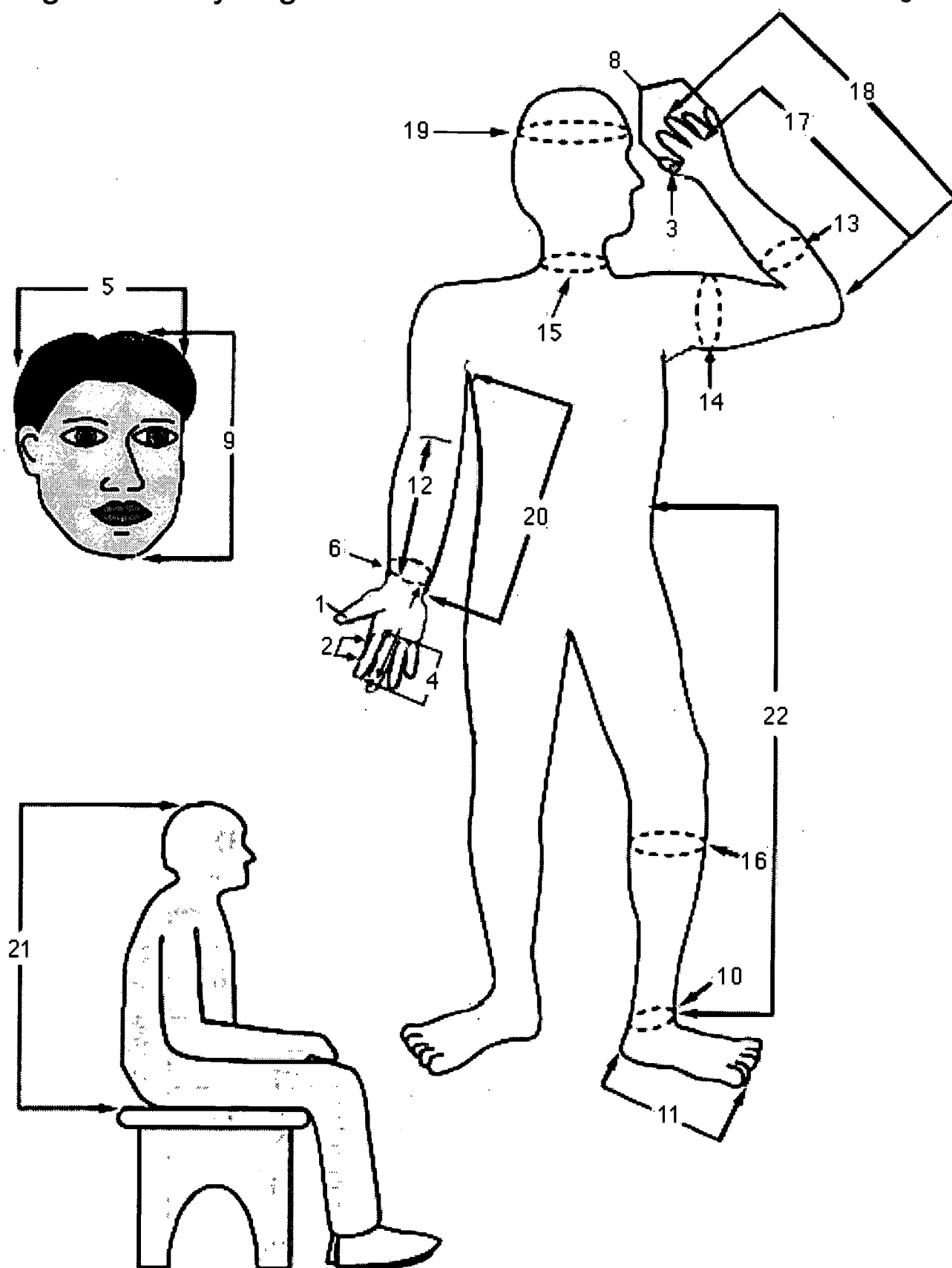
(Number 20 is not on this diagram. Refer to your lab sheet for details.)



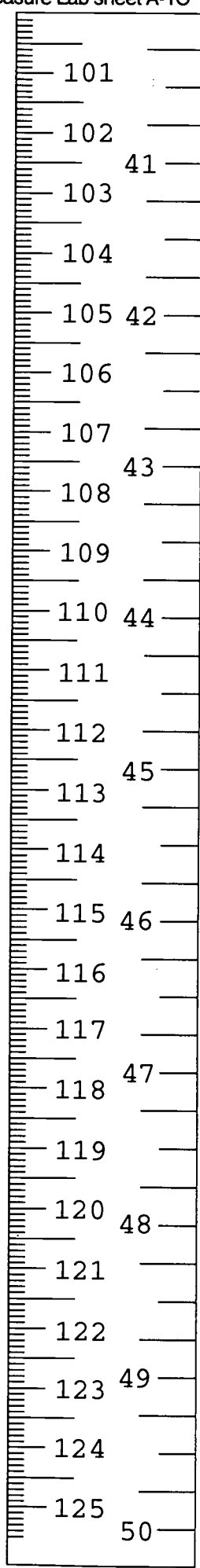
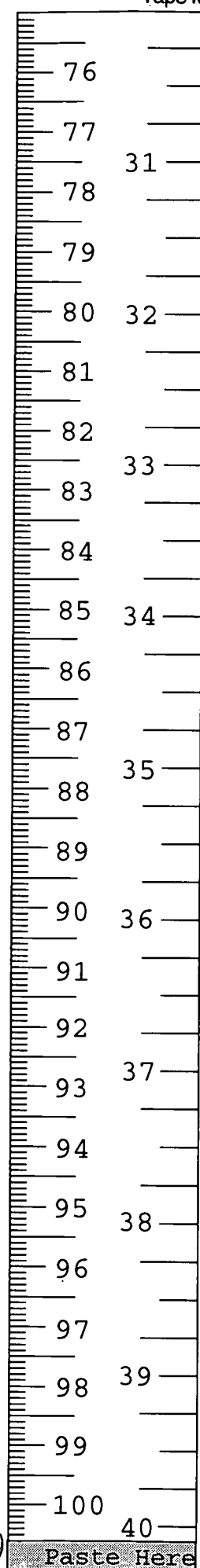
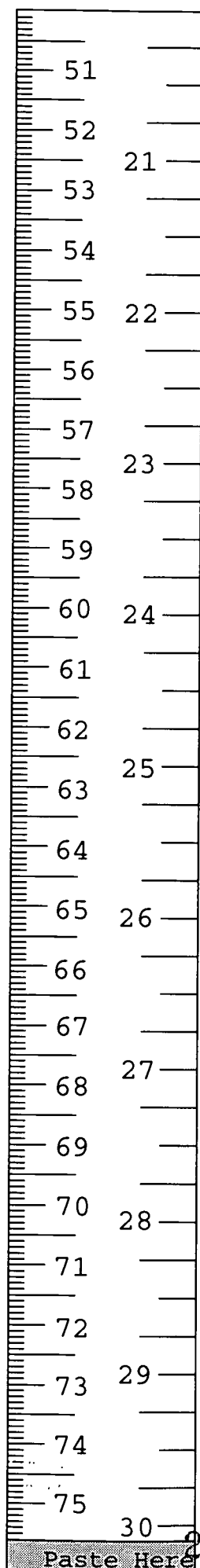
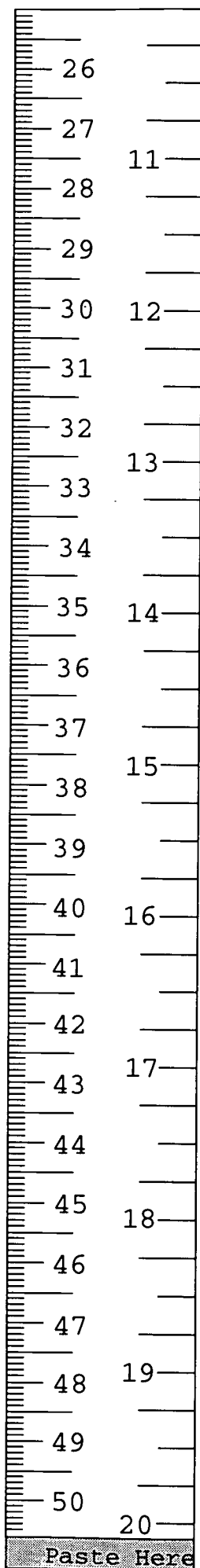
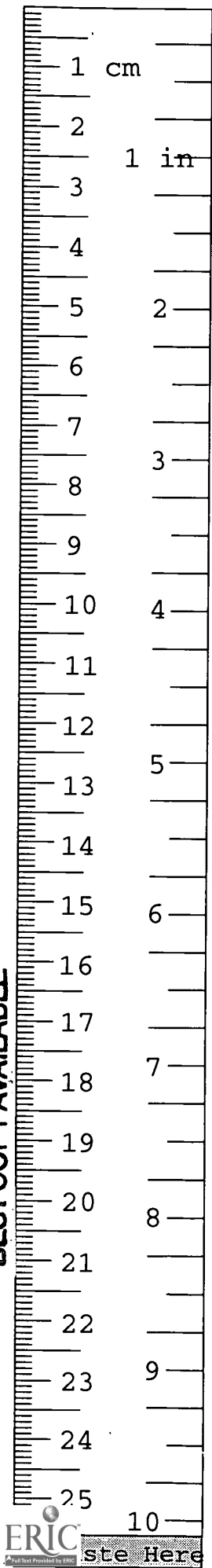
NAME: \_\_\_\_\_

# Diagram of Body Regions to be Measured

Lab Sheet A-1B Page 2



BEST COPY AVAILABLE



NAME \_\_\_\_\_

# HOW DO I MEASURE UP?

## Metric Practice

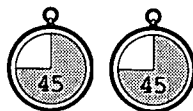
\* Denotes an optional measurement

Measurements to be taken in cm

	MOM Measure	DAD Measure
1. Width of thumb nail		
2. Length of mid-digit of index finger		
3. Circumference (distance around) of thumb knuckle		
4. Length of index finger (from crease)		
5. Circumference of wrist		
6. Hand span (wrist crease to finger tip)		
7. Hand spread (the greatest distance you can obtain by spreading your hand on the table and measuring from thumb to tip of little finger)		
*8. Circumference of ankle (smallest part)		
9. Length of foot (standing with shoe off)		
10. Distance from wrist to crease inside of arm (near elbow)		
11. Circumference of forearm		
*12. Circumference of biceps (flexed)		
*13. Circumference of neck		
*14. Circumference of calf muscle (flexed)		
15. Short "cubit" (distance from tip of elbow to knuckle of clenched fist)		
16. Long "cubit" (distance from tip of elbow to the tip of finger)		
17. Circumference of head (taken just above ears and eyebrows)		
18. Length of arm (under arm to finger tip)		
19. Outside leg length (natural waistline to sole of foot)		
20. Length of reach (measure from fingertip to fingertip when arms are spread out to the sides)		
21. Your height (without shoes)		

## LESSON TWO: "Viva la Difference!"

**TIME:** two 45-minute classes



**OBJECTIVES:** Using height measurements from the previous lab sheet, the Student will:

1. Construct a bar graph of group data;
2. Determine class average for males and females; and
3. Compare and contrast class results with national norms.

### VOCABULARY:

conclusion: a reasoned judgment based on a hypothesis

hypothesis: an educated guess, based on gathered data to explain a phenomenon

national norm: an average on a national level

### MATERIALS AND EQUIPMENT:

Lab Sheet A-1A (from previous lesson)

Lab Sheet A-2A

national norms A-2B (for boys) and A-2C (for girls)

stadiometer or wall tape

water-based marker

overhead projector and transparency sheet, or teacher-made chart for class results

Optional:

calculators and colored pencils

### PREPARATION:

1. Duplicate Lab Sheet A-2A, one per student.
2. If using data from the previous lesson, make sure students have Lab Sheet A-1A.
3. Have sheets of national norms A-2B and A-2C available.
4. Make overhead transparency of A-2A.

### PROCEDURE:

1. Divide students into small groups, making sure that each group has members of both sexes in it.
2. Distribute Lab Sheet A-2A, one per student.
3. Pose the question, "Is there a relationship of average heights between males and females in your class? Explain and record your answer."
4. Define "hypothesis." Direct the student to formulate his/her own height-related hypothesis: (a) the average height will be the same; (b) boys' average height will be taller; or (c) girls' average height will be taller.
5. List and discuss all the hypotheses the students have generated. (Steps 2 and 3 on Lab Sheet A-2A are to be completed at this time.)
6. Take height data from previous lesson or measure for height and complete group data (Lab Sheet A-2A, Step 4).
7. Write group totals on an overhead transparency of A-2A (Step 5).

8. Have students transfer data from overhead to Lab Sheet A-2A (Step 5).
9. Complete remainder of Step 5.
10. Formulate a conclusion based on classroom data that refutes or supports your hypothesis. (Lab Sheet A-2A, Step 6, is to be completed at this time.)
11. Compare and contrast individual and class averages with national norms, using Lab Sheets A-2B and A-2C. What similarities and differences were discovered?
12. Graph results of Lab Sheet A-2A. (Use discretion as to the type of graph and information to be used.)

Optional:

13. Create a large graph on the wall to plot average heights over time; for example, over a semester or year.
14. After several measurements, have the students hypothesize what they think the averages will be by the end of the school year.
15. Have the students share the information with their pediatricians, to predict their adult height.
16. Measure students in different grades. Are there any differences?

#### **EVALUATION:**

1. Completion of Lab Sheet A-2A and graph.

Optional:

2. Completion of Steps 13 - 16.

#### **RESOURCES:**

1. pediatrician, pediatric nurse practitioner, and/or school nurse.

NAME: \_\_\_\_\_

## VIVA LA DIFFERENCE

1. Problem: Is there a relationship between the heights of males and females in your class? Explain why.

2. Write your hypothesis:

3. Why did you select this hypothesis?

4. Group Data

Girl #1 \_\_\_\_\_ cm

Girl #2 \_\_\_\_\_ cm

Girl #3 \_\_\_\_\_ cm

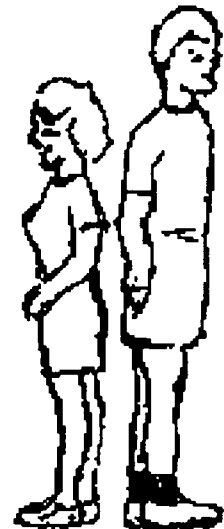
Girl Total \_\_\_\_\_ cm

Boy #1 \_\_\_\_\_ cm

Boy #2 \_\_\_\_\_ cm

Boy #3 \_\_\_\_\_ cm

Boy Total \_\_\_\_\_ cm



5. Class Data

<u>Group #</u>	<u>Girl Totals</u>	<u># of girls in group</u>	<u>Boy Totals</u>	<u># of boys in group</u>
----------------	--------------------	----------------------------	-------------------	---------------------------

1	_____	_____	_____	_____
2	_____	_____	_____	_____
3	_____	_____	_____	_____
4	_____	_____	_____	_____
5	_____	_____	_____	_____
6	_____	_____	_____	_____
7	_____	_____	_____	_____
8	_____	_____	_____	_____
9	_____	_____	_____	_____
10	_____	_____	_____	_____

TOTALS: \_\_\_\_\_

\_\_\_\_\_

Average = Total height of gender ÷ # of students in that group

Girls Average \_\_\_\_\_ cm

Boys Average \_\_\_\_\_ cm

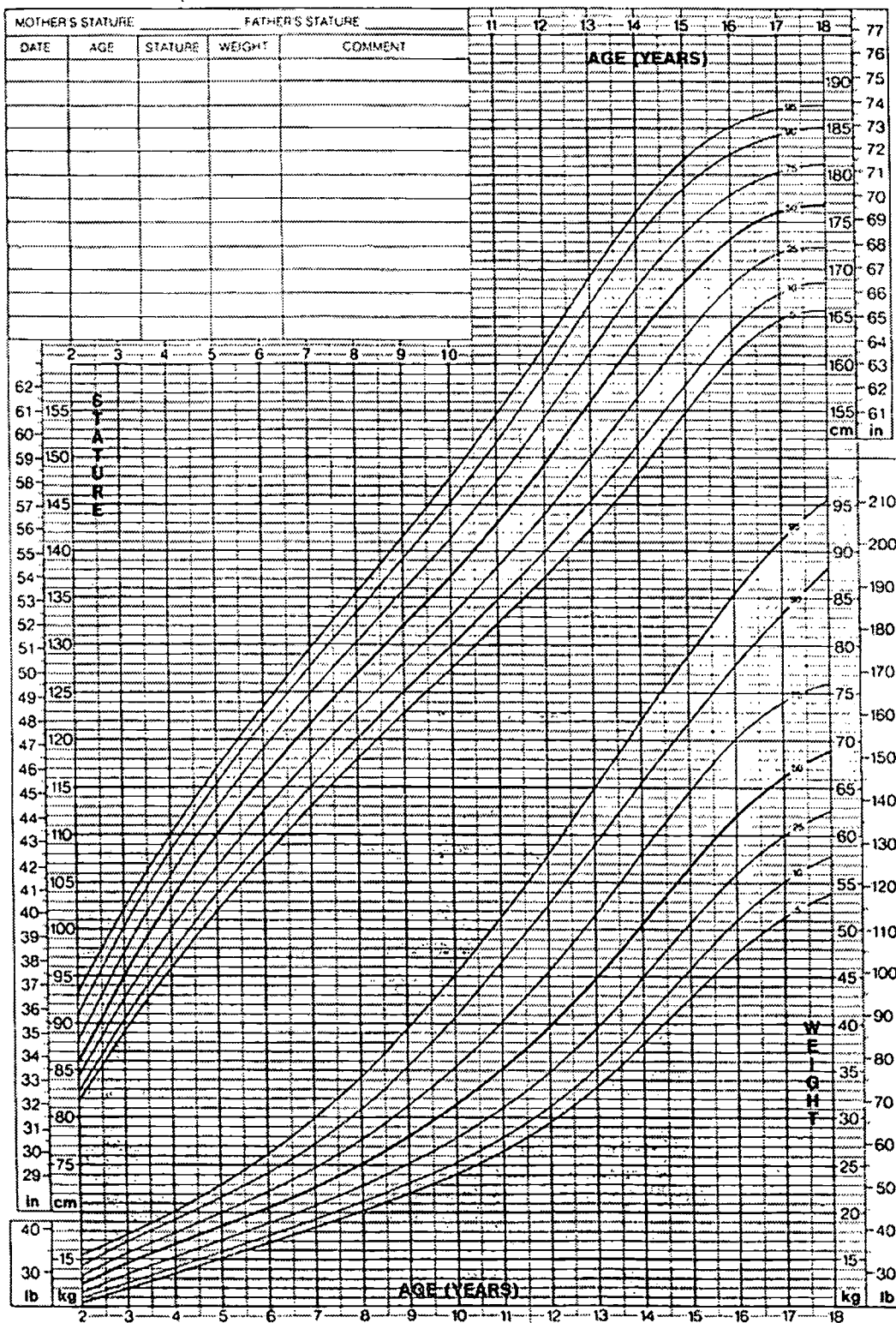
6. Conclusion:



**BOYS: 2 TO 18 YEARS  
PHYSICAL GROWTH  
NCHS PERCENTILES\***

NAME

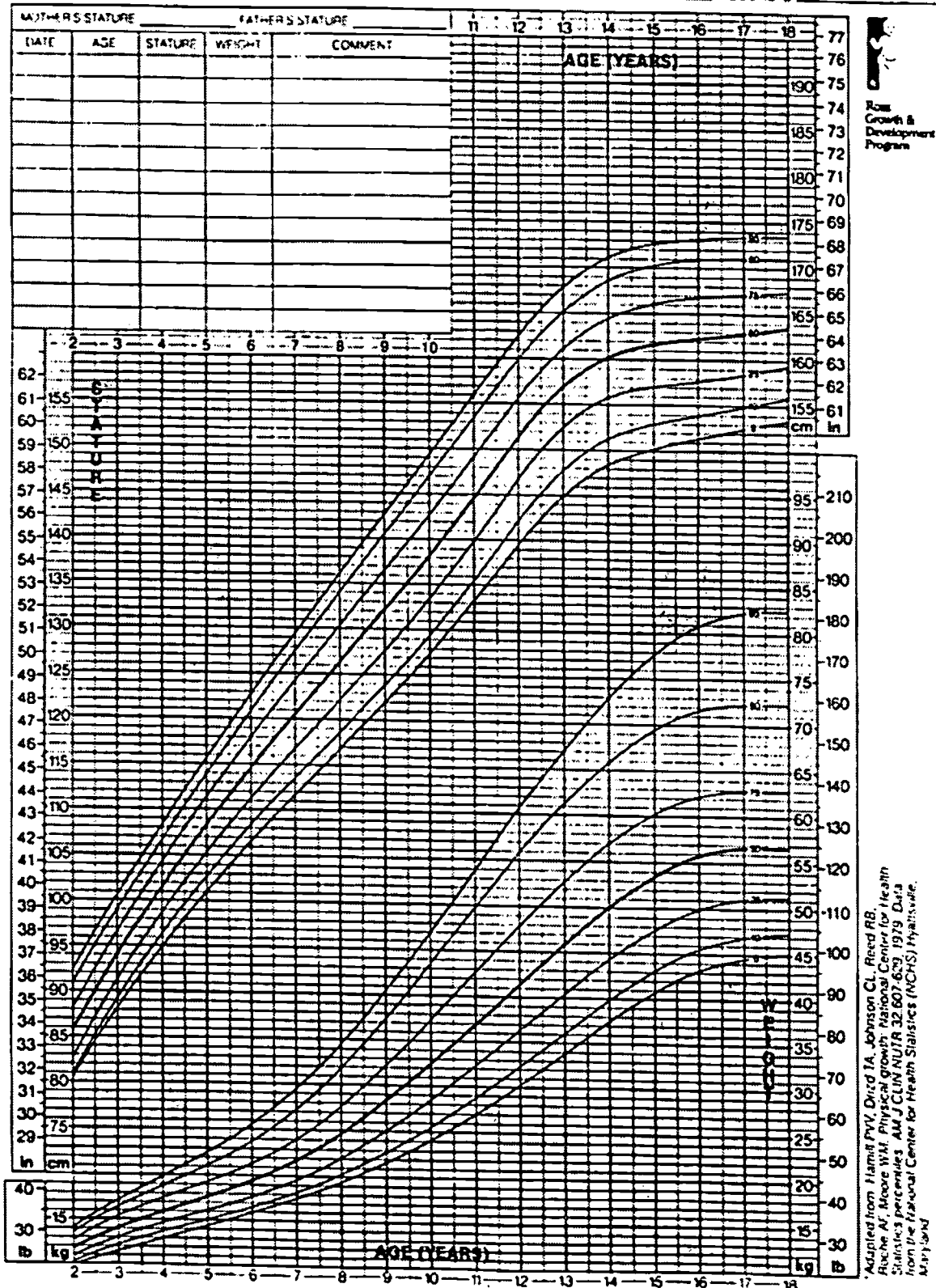
RECORD #



Adapted from: Hamill PVV, Drizd TA, Johnson CL, Reed RB, Roche AF, Moore WM. Physical growth: National Center for Health Statistics percentiles. *AM J CLIN NUTR* 32:607-629, 1979. Data from the National Center for Health Statistics (NCHS), Hyattsville, Maryland.

NAME \_\_\_\_\_

**RECORD #**



Adapted from Hamill PVV, Drizd TA, Johnson CL, Reed RB, Roche AF, Moore WM. Physical growth: National Center for Health Statistics percentiles. *AM J CLIN NUTR* 32:607-639, 1979. Data from the National Center for Health Statistics (NCHS) Hyattsville, Maryland.

### LESSON THREE: "Pinch an Inch"

**TIME:** one 45-minute class



**Note to Teacher:** The main goal of this lesson is for students to understand the ratio of the body's fat mass to the body's total mass. Calculating percent body fat can be a highly sensitive subject for both students and teachers. Although calculating percent body fat with a ruler or calipers on your own students is a valid exercise in the scientific process, the data generated from these measures can be compared to standardized tables that show acceptable ranges for percent body fat according to age and sex. The extra body fat in females cushions the reproductive organs and provides extra energy during pregnancy.

**OBJECTIVES:** The Student will:

1. Demonstrate an understanding of the importance of percent body fat; and
2. Determine his/her relationship to a standardized table for percent body fat.

#### **VOCABULARY:**

adipose tissue: connective tissue in which fat is stored

percent body fat: the ratio of the body's fat mass to the body's total mass

tricep: the muscle along the back of the upper arm

#### **MATERIALS AND EQUIPMENT:**

Lab Sheet A-3A

ruler with English measurement

#### **PREPARATION:**

1. Duplicate Lab Sheet A-3A, one per student.
2. Read the following Facts for Teacher:

The average female's body weight is about 26% fat, while the average male's body weight is about 18% fat. These are average figures, and aren't necessarily ideal. A certain amount of body fat is needed to maintain body temperature at 98.6 degrees Fahrenheit, or 37 degrees centigrade. Body fat is also needed to protect many internal organs such as the kidneys. Experts recommend that a healthy body fat for girls and women is from 20% to 25%; men and boys should aim for 12% to 17%. Body fat above 25% for young women and 17% for young men can be uncomfortable and may make the heart's job more difficult.

It's important to know that having less body fat than is recommended may be harmful. Athletes may have lower body fat percentages as a result of vigorous sports training programs. Although very low percentages of body fat may be healthy for athletes, they aren't recommended for most of us, because we need a normal amount of body fat to maintain healthy body functions. With the right amount of exercise and good eating habits, you can stay within the recommended limits for your age and sex, and like what you see in the mirror.

**PROCEDURE:**

1. Demonstrate to students proper usage of a ruler to determine percent body fat.
2. Divide students into small groups.
3. Distribute and complete Lab Sheet A-3A.
4. Discuss why boys and girls with the same ruler measurements have different percent body fat (see Lab Sheet A-3A).
5. Assign a short paper that asks students to reflect on what it is in their own lifestyle that contributes to their percent body fat. If they are above or below normal, according to the facts in Step 1, Preparation, consider the causes. If they are within the normal range, have them consider the behaviors they should continue.

**EVALUATION:**

1. Completion of Lab Sheet A-3A.
2. Completion of short paper.

**RESOURCES:**

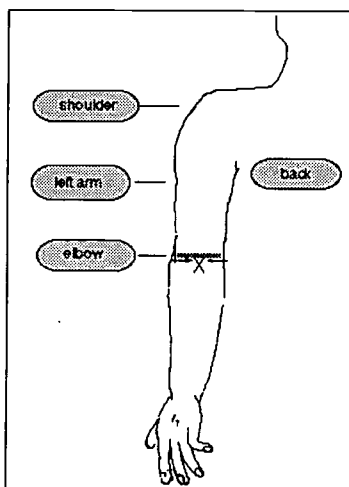
1. Powers SK and Howley ET, Exercise Physiology, WC Brown Pub., NY, 1990, p. 385.
2. Wardlaw GM and Insel PM, Perspectives in Nutrition, Times-Mirror/ Mosby College Publishing, St. Louis, 1990, pp. 222 - 51.
3. Guest speakers (exercise physiologist, nutritionist, and sports medicine personnel).
4. PBS video item, "Fit or Fat."
5. Wardlaw GM and Insel PM, Contemporary Nutrition, Mosby - Yearbook, Inc., St. Louis, 1994. ISBN 0-8016-7760-2.

NAME: \_\_\_\_\_

## PINCH AN INCH

Estimating Body Fat Percentage with a Ruler:

1. Bend your left arm.
2. Have your lab partner measure the distance from the top of your shoulder to the tip of your elbow. Find the halfway point and put a small mark on the back of your arm.
3. Let your left arm fall into a relaxed position with your hand down to your side.
4. Have your lab partner pinch your skin at the point marked. With one hand pull the skin and fat away from the muscle. With the other hand, hold the ruler. (see illustration)
5. Measure the distance of the tricep skinfold twice, and record these measurements.



\_\_\_\_\_ inch(es)  
(measurement 1)

\_\_\_\_\_ inch(es)  
(measurement 2)



6. Determine the average of the two measurements and record below.

$$\frac{\text{measurement 1} + \text{measurement 2}}{2} = \frac{\quad + \quad}{2} = \quad \text{(average skinfold)}$$

7. Using the following data determine your approximate percentage of body fat.

Girls' skinfold

thickness	1/4"	1/2"	3/4"	1"	1 1/4"
-----------	------	------	------	----	--------

% of Body fat	8-13%	13-18%	18-23%	23-28%	28-33%
---------------	-------	--------	--------	--------	--------

Boys' skinfold

thickness	1/4"	1/2"	3/4"	1"	1 1/4"
-----------	------	------	------	----	--------

% of body fat	5-9%	9-13%	13-18%	18-22%	22-27%
---------------	------	-------	--------	--------	--------

Fat can be unevenly distributed over the body, so an upper arm measurement may not be the best picture of your total body fat. Remember, it's the whole picture that counts.



## LESSON FOUR: "Squeeze It"

**TIME:** one 45-minute class



Note to Teacher (from Ross Labs Growth and Development Program): The National Center for Health Statistics (NCHS) collected data from some 20,000 children. The results of the survey are given. The NCHS percentiles described the distribution of those children measured. For example: 90% of the children were at or below the 90th percentile on all graphs. Likewise, 50% of the children were at or below the 50th percentile on all graphs. The percentiles may be used as reference data but should not be considered "ideals." It is inappropriate to conclude that a measurement above or below an arbitrary percentile is unacceptable. However, mid-arm circumference and skinfold measurements are useful for screening and monitoring the progress of an individual who has been identified as having a potential for undernutrition or overeating.

**OBJECTIVES:** The Student will:

1. Learn to use a skinfold caliper properly;
2. Determine where he/she is in relationship to national norms for mid-arm circumference and tricep skinfold thickness;
3. Demonstrate an understanding of the differences between percent body fat and percentiles on national norm charts; and

Optional:

4. Calculate percent body fat using two skinfold measurements.

### VOCABULARY:

adipose tissue: connective tissue in which fat is stored

body density: ratio of the body's mass to its volume

mass: the amount of material an object or body contains

percentile: a value on a scale of 1 to 100 that indicates the percent of a distribution that is equal to, or below it

skinfold caliper: measuring instrument with two legs that can be adjusted to determine skinfold thickness

volume: cubic capacity of an object or body

### MATERIALS AND EQUIPMENT:

one skinfold caliper per group

Lab Sheets A-4A

standardized graphs A-4B and A-4C

metric tape measures

red and blue colored pencils

Optional:

Lab Sheets A-4D

one calculator per group

**PREPARATION:**

1. Become familiar with caliper use as shown on Lab Sheets A-4A.
2. Duplicate Lab Sheets A-4A and graphs A-4B and A-4C, one per student.
3. For completion of Step 10 on Lab Sheet A-4A, be prepared to emphasize that the percentile for mid-arm circumference does not necessarily correlate to the percentile for a tricep skinfold. For example, two students may have the same "large" mid-arm circumference, one from exercise, and the other from lack of exercise and overeating. Therefore, both students will find themselves in the upper percentiles for mid-arm circumference. However, their individual differences in muscle tone will cause them to have a different skinfold thickness percentile.

**PROCEDURE:**

1. Demonstrate to students the proper use of the skinfold caliper. Take extra care for children who bruise easily.
2. Divide students into small groups and have them demonstrate proper use of the skinfold caliper.
3. Distribute and complete Lab Sheets A-4A through Step 9.
4. Discuss the differences between percent body fat and skinfold thickness percentiles (see Lab Sheets A-4A, Step 10).

Optional:

5. Group students by gender and have them complete Lab Sheets A-4D.

**EVALUATION:**

1. Completion of Lab Sheets A-4A and graphs A-4B and A-4C.

Optional:

2. Completion of Lab Sheets A-4D.

**RESOURCES:**

1. Powers SK and Howley ET, Exercise Physiology, WC Brown Pubs., NY 1990, p.385.
2. Cooper K, Kid Fitness, Bantam Books, NY, 1991, pp. 110-11.

NAME: \_\_\_\_\_

# SQUEEZE IT

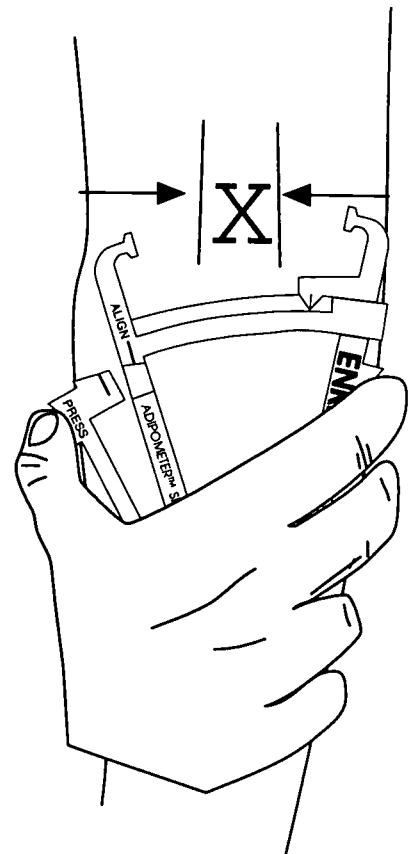
## Procedures:

1. Record your age in \_\_\_\_\_ years and \_\_\_\_\_ months. Gender \_\_\_\_\_.
2. Bend your left arm.
3. Have your lab partner measure the distance from the top of your shoulder to the tip of your elbow. Find the half-way point and put a small mark on the back of your arm.
4. Let your left arm fall into a natural relaxed position with your hand down to your side.
5. Using a metric measuring tape, or string and metric ruler, determine the circumference of your midarm at the midpoint mark. What is your midarm circumference? \_\_\_\_\_ cm
6. Locate the appropriate midarm circumference graph for your gender (A-4B). Plot your data on the graph. Use a red dot for yourself and a blue dot for your partner.
7. To take the tricep skinfold measurement, have your lab partner vertically pinch the area just above the midpoint, and gently pull the skin away from the arm. This will separate the skin and fat from the underlying muscle tissue. While still holding the pinched skin with your fingers, take the caliper measurement just below the pinched area (see illustration). Be sure to align the arrows as you read the measurement.
8. Take three measurements at the tricep area and record them below. Lab partners will use the calipers on each other. The "median" measurement (middle, or most often repeated number) is the answer that will be graphed.

What are your tricep skinfold measurements?

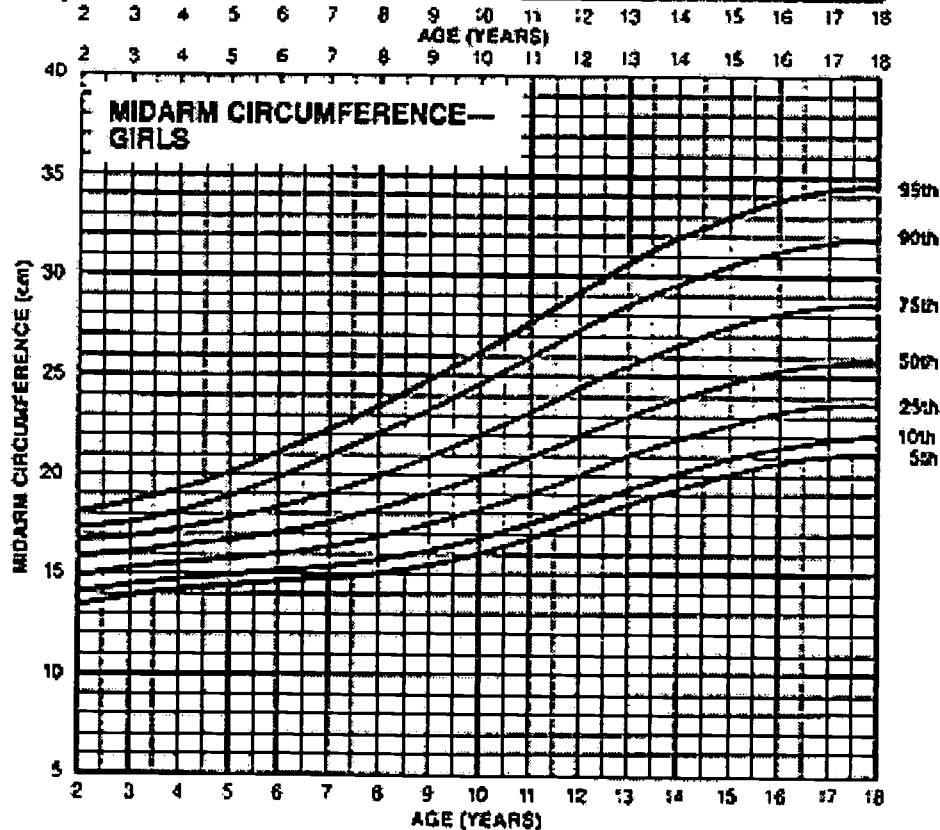
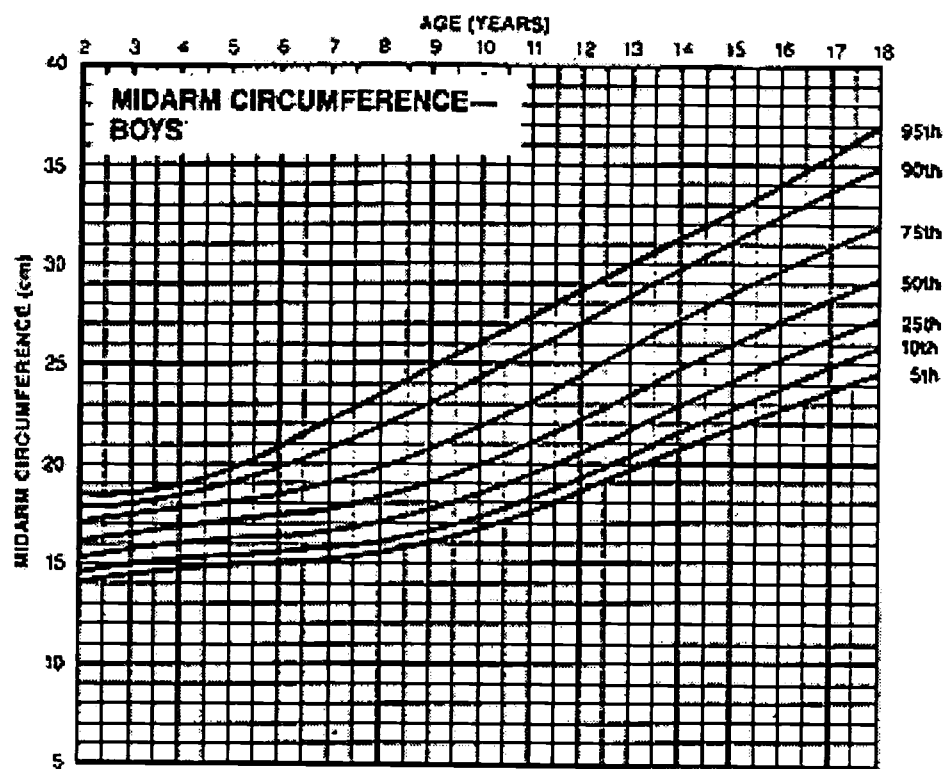
#1 \_\_\_\_\_ mm  
 #2 \_\_\_\_\_ mm  
 #3 \_\_\_\_\_ mm

median = \_\_\_\_\_ mm

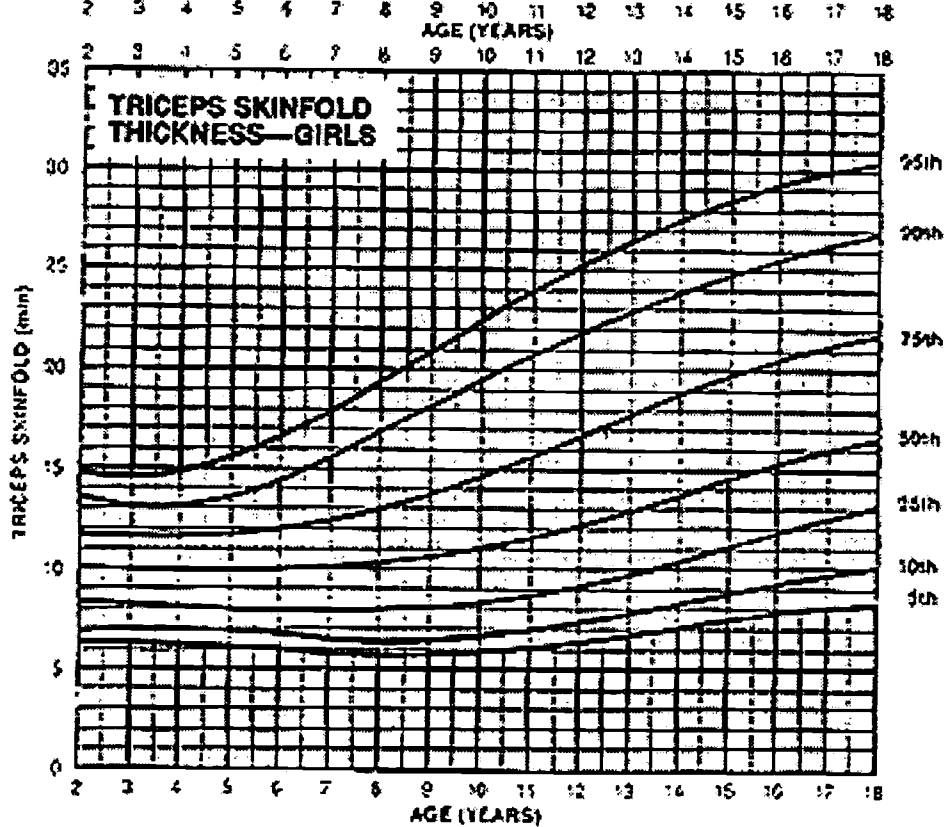
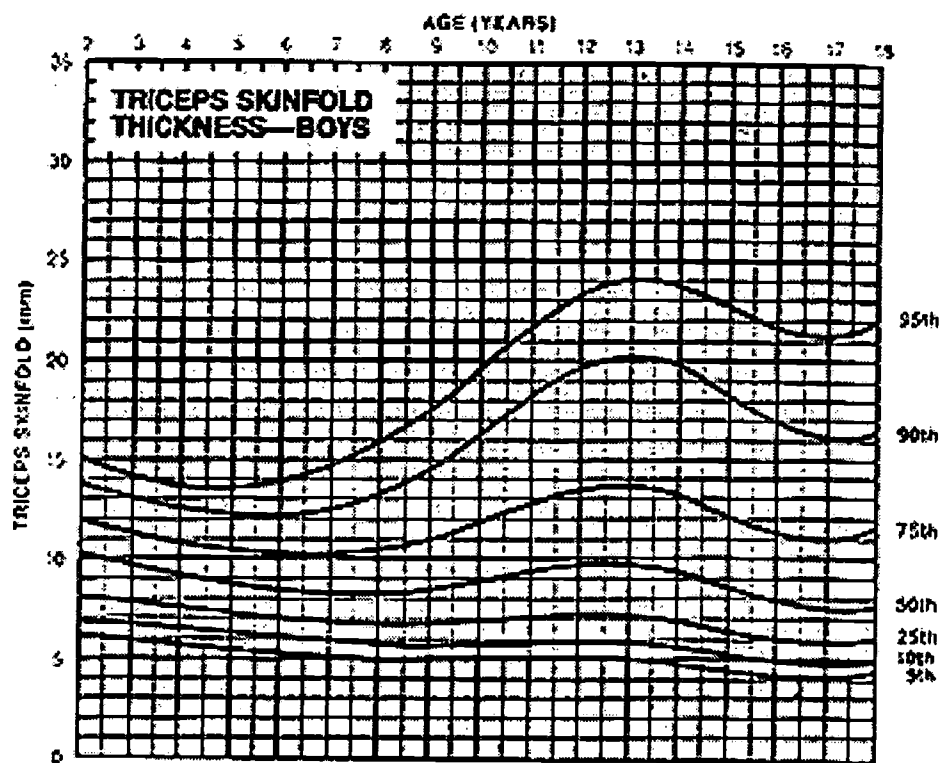




9. Plot the results on the appropriate skinfold thickness graph for your gender on Lab Sheet A-4B. Plot your median as a red dot and your lab partner's median as a blue dot.
10. Does a relationship exist between the results from percent body fat, and percentiles for midarm circumference? Does a relationship exist between percentile for midarm circumference and the percentile for tricep skinfold thickness? Discuss reasons **why or why not**.



Figures are adapted from Johnson CL, Fulwood R, Abraham S, et al: Basic data on anthropometric measurements and angular measurements of the hip and knee joints for selected age groups, 1-74 years of age. United States, 1971-1975. Vital and Health Statistics Series II, No. 219. DHHS Publication No. (PHS) 81-1669, 1981. 1983 Ross Laboratories, Columbus, Ohio 43216. May be copied for individual patient use.



Figures are adapted from Johnson CL, Fulwood R, Abraham S, et al: Basic data on anthropometric measurements and angular measurements of the hip and knee joints for selected age groups, 1-74 years of age. United States, 1971-1975. Vital and Health Statistics Series II, No. 219. DHHS Publication No. (PHS) 81-1669, 1981. 1983 Ross Laboratories, Columbus, Ohio 43216. May be copied for individual patient use.

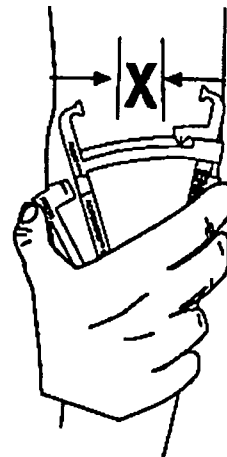
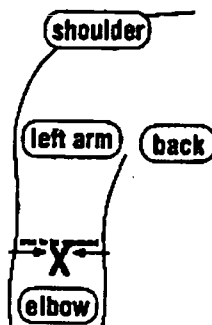
NAME: \_\_\_\_\_

Optional Lab Sheet A-4D Page 1

# SQUEEZE IT

## Procedure:

The following calculations are used to determine body density and percent body fat. Different formulas must be used for males and females. These formulas are used with skinfold thickness measurements from two different regions of the body. Women will use measurements from the tricep and the suprailiac (see illustration). Men must use measurements from the front of the thigh and the subscapula region (see illustration).



Sample data is provided to calculate body density.

### WOMEN

Skinfold Assessment (millimeters)

	Trial 1	Trial 2	Trial 3	Mean
1. Tricep	13.0	16.0	15.0	15.5
2. Suprailiac	7.5	8.0	7.5	7.5

Computation for Body Density (gm/cc)

$$\begin{aligned} \text{Body Density} &= 1.0764 - (0.00088 \times \text{tricep}) - (0.00081 \times \text{suprailiac}) \\ &= 1.0764 - (0.00088 \times 15.5) - (0.00081 \times 7.5) \\ &= 1.0764 - (.01364) - (.00608) \end{aligned}$$

$$\text{Body Density} = 1.057 \text{ gm/cc}$$

On the lines provided simply use your skinfold measurements to determine body density.

Skinfold Assessment (millimeters)

	Trial 1	Trial 2	Trial 3	Mean
1. Tricep	_____	_____	_____	_____
2. Suprailiac	_____	_____	_____	_____

Computation for Body Density (gm/cc)

$$\begin{aligned} \text{Body Density} &= 1.0764 - (0.00088 \times \text{tricep}) - (0.00081 \times \text{suprailiac}) \\ &= 1.0764 - (0.00088 \times \text{_____}) - (0.00081 \times \text{_____}) \\ &= 1.0764 - (\text{_____}) - (\text{_____}) \end{aligned}$$

$$\text{Body Density} = \text{_____ gm/cc}$$

### MEN

Skinfold Assessment (millimeters)

	Trial 1	Trial 2	Trial 3	Mean
1. Subscapula	11.5	11.0	11.0	11.0
2. Thigh	15.0	15.0	—	15.0

Computation for Body Density (gm/cc):

$$\begin{aligned} \text{Body Density} &= 1.1043 - (0.00131 \times \text{subscapula}) - (0.001327 \times \text{thigh}) \\ &= 1.1043 - (0.00131 \times 11.0) - (0.001327 \times 15.0) \\ &= 1.1043 - (.01441) - (.01991) \end{aligned}$$

$$\text{Body Density} = 1.070 \text{ gm/cc}$$

Skinfold Assessment (millimeters)

	Trial 1	Trial 2	Trial 3	Mean
1. Subscapula	_____	_____	_____	_____
2. Thigh	_____	_____	_____	_____

Computation for Body Density (gm/cc):

$$\begin{aligned} \text{Body Density} &= 1.1043 - (0.00131 \times \text{subscapula}) - (0.001327 \times \text{thigh}) \\ &= 1.1043 - (0.00131 \times \text{_____}) - (0.001327 \times \text{_____}) \\ &= 1.1043 - (\text{_____}) - (\text{_____}) \end{aligned}$$

$$\text{Body Density} = \text{_____ gm/cc}$$

NAME: \_\_\_\_\_

Optional Lab Sheet A-4D Page 2

Using the following formulas, calculate your percent body fat:

1. children 9-11 years       $(530 \div \text{body density}) - 489 = \% \text{ body fat}$
2. children 12-15 years       $(509 \div \text{body density}) - 465 = \% \text{ body fat}$
3. adults (Caucasian)       $(495 \div \text{body density}) - 450 = \% \text{ body fat}$
4. adults (African Americans)  $(437 \div \text{body density}) - 393 = \% \text{ body fat}$

Determine your percent body fat here.

## RESOURCES FOR MODULE 1: ANTHROPOMETRY

### Strongly Recommended:

Wardlaw GM and Insel PM, Perspectives in Nutrition, Times-Mirror/ Mosby Pub., St. Louis, 1990. ISBN 0-8016-7244-9.

Wardlaw GM and Insel PM, Contemporary Nutrition, Mosby - Yearbook, Inc., St. Louis, 1994. ISBN 0-8016-7760-2.

Cooper K, Kid Fitness, Bantam Books, NY, 1991. ISBN 0-5530-7332-X.

Guest speakers: exercise physiologist, nutritionist, sports medicine personnel, pediatrician, pediatric nurse practitioner, and/or school nurse.

PBS Video, "Fit or Fat."

### Other Resources:

Allison L, Blood and Guts: a Working Guide to Your Insides, Brown Paper School Book, NY, 1976. ISBN 0-3160-0344-8 (Hardback); ISBN 0-3160-3443-6 (Paperback).

Broekel R, Your Skeleton and Skin: A New True Book, Childrens Press, Chicago, 1984. ISBN 0-5160-1934-1.

Ohio Health Promotion Network, Bureau of Health Promotion and Education, Ohio Department of Health, P. O. Box 118, Columbus, OH 43266-0118. (614) 644-7852. Various educational materials.

Powers S and Howley E, Exercise Physiology, WC Brown Pub., NY, 1990. ISBN 0-6970-0505-X.

Richardson J, Science Dictionary of the Human Body, Troll Associates, Mahwah, NJ, 1992. ISBN 0-8167-2442-3.

## MODULE 2: BONE CHEMISTRY AND COMPOSITION

In this module the Student will:

Lesson One:

- (a) Observe skeletal parts and how they are connected.
- (b) Identify and assemble skeletal parts.
- (c) Draw conclusions about the type of bones and their functions.

Lesson Two:

- (d) Observe and record the process of demineralization using a raw egg.

Lesson Three:

- (e) Observe the role of removing minerals and collagen from bones.
- (f) Compare the elasticity and hardness of mineralized and demineralized bones.
- (g) Compare objects that have either hardness or elasticity with bones.

Lesson Four:

- (h) Describe the continuous process of absorption and resorption.
- (i) Develop classifications of different types of broken bones.
- (j) Diagram and label the mending process of a broken bone.
- (k) Explain the significance of growth plates and how they may be affected by a fracture.

Lesson Five:

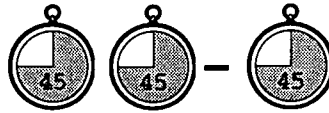
- (l) Observe and label the external and internal composition of bone.

Lesson Six:

- (m) Describe the difference between normal and osteoporotic bone.
- (n) List at least three ways to maintain healthy bones.
- (o) List the common risk factors for osteoporosis.

## LESSON ONE: "No Bones About It"

**TIME:** two to three 45-minute classes



**Note to Teacher:** To prepare for this entire module, please read "What Bones Teach Us" and the archeology fact sheets located at the end of the module. You may also want to review and/or copy B-1C before this particular lesson.

**OBJECTIVES:** The Student will:

1. Observe skeletal parts and how they are connected;
2. Identify and assemble skeletal parts; and
3. Draw conclusions about types of bones and their functions.

### VOCABULARY:

carnivore: a meat-eating animal

environment: the circumstances, objects, or conditions by which one is surrounded

habitat: the place or type of site where a plant or animal lives

herbivore: a plant-eating animal

omnivore: an animal that eats both plants and animals

predator: an organism that attacks and eats prey

prey: an animal eaten by a predator

### MATERIALS AND EQUIPMENT:

owl pellets, one per group (if obtained from the wild, these need to be individually wrapped in aluminum foil and baked at 350° F for 35 minutes)

trays with black liners, one per group

tweezers or forceps

magnifiers

Instructions for Pellets B-1A (Pellets, Inc.)

Optional:

Question Sheet B-1B

Call or write Pellets, Inc., 3004 Pinewood, Bellingham, WA 98225 (206) 733-3012

A study of raptor with owl pellets (Connecticut Valley Biological), Lab Sheet B-1C

Disarticulated small animal skeletons, one per group

Chicken or turkey skeletons, prepared by the instructor

construction paper and glue

### PREPARATION:

1. Obtain necessary materials.

2. Duplicate Lab Sheet B-1A.

Optional:

3. Duplicate Lab Sheets B-1B and B-1C as necessary.



**PROCEDURE:**

1. Divide students into small groups.
2. Distribute owl pellets, trays, tweezers, forceps, magnifiers, and all lab sheets.
3. Examine and dissect owl pellets following instructions on Lab Sheet B-1A.
4. Discuss student observations.

**Optional:**

5. Complete Question Sheet B-1B.
6. Mount skeletons on construction paper with glue and include appropriate labels.

**EVALUATION:**

1. Completion of Lab activity.

**Optional:**

2. Completion of Question Sheet B-1B.
3. Completion of mounting and labeling of skeleton.

**RESOURCES:**

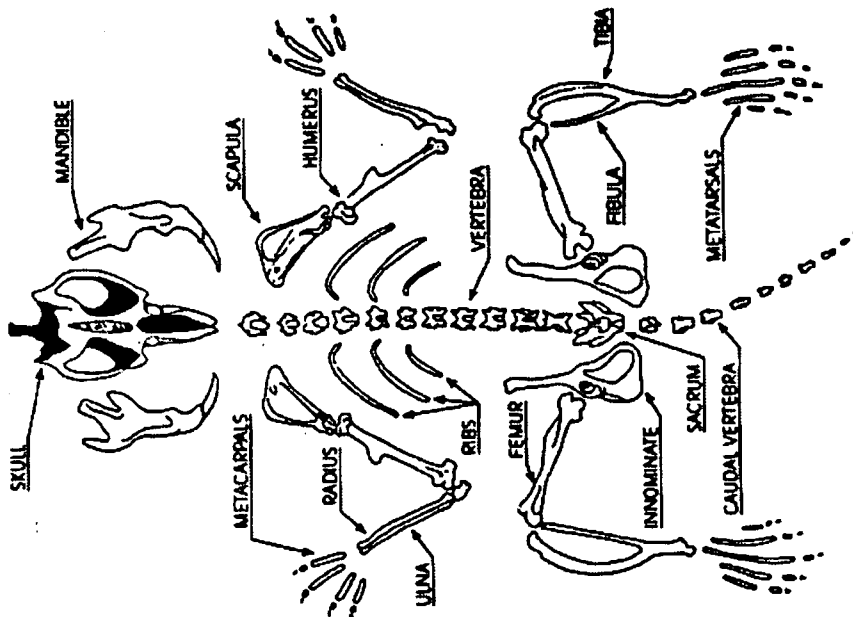
1. Bumie D, Birds, Eyewitness Books, Knopf Pub., NY, 1988, pp. 7, 42-3.
2. Parker S, Skeleton, Eyewitness Books, Knopf Pub., NY, 1988.
3. School of veterinary medicine in your area, or local veterinarian.
4. Natural resources service in your area or biological supply companies.

NAME: \_\_\_\_\_

Lab Sheet B-1A

## THE PELLET PUZZLE

1. Carefully unwrap your pellet on a clean working surface.
2. Inspect your pellet; note: size, bones, feathers, or any clues about where the pellet came from. You are a scientist.
3. Very gently, pull apart your pellet, being very careful not to break any bones. (Some teachers prefer to soak the pellet in water; others prefer to work with a dry pellet.)
4. Carefully separate the bones from the fur or feathers. Teasing needles or tooth picks work well. Take special care removing skulls and jaws because they are the best way to identify the animals.
5. Look for evidence of the wool eating moth life cycle; eggs (tiny), pupae casings, cocoons or larvae.
6. Roll the last bits of fur between your fingers to find little bones or teeth that may have been overlooked.
7. Try to lay out or reconstruct the skeletons of the animals you have found.



NAME: \_\_\_\_\_

**NO BONES ABOUT IT****QUESTION SHEET**

1. What do the skeletons have in common?
2. Do bones that have the same function have the same basic shape?  
Give two reasons to support your conclusion.
3. How many legs did the animal have?  
Did it have claws? If so, how many?  
Are the legs different lengths and sizes?  
Did it have a tail or wings?
4. What do you think the animal's height, length and weight were when it was alive?
5. Where might the animal have lived?
6. What kind of animal do you think you have?
7. How do the various bones help you identify the kind of animal and the life it lives?
8. Is this animal a carnivore, herbivore, or omnivore?  
What part of the animal skeleton can you identify that supports your conclusion?
9. In what ways could this animal defend itself?  
What evidence do you have to support this conclusion?
10. In what kind of habitat did this animal live?
11. Draw the animal you think you have in its habitat.

NAME: \_\_\_\_\_

Optional Lab Sheet B-1C Page 1

## THE STUDY OF RAPTORS WITH OWL PELLETS

### Introduction to Raptors

Owls, hawks, and eagles all belong to a group of birds known as **raptors**, or birds of prey. Raptors actively hunt other animals, particularly other vertebrates, for food, and play an important role in the control of many species considered pests by man. This is largely due to their ability to move from one area to another, sometimes great distances within a relatively short period of time, in response to fluctuations in prey populations. Raptors also exert 24 hour pressure on prey species in the form of nocturnal predation by owls and diurnal predation by hawks and eagles. Each species is superbly adapted to reduce interspecies competition to a minimum by employing different hunting techniques, hunting different habitats, different prey, or by hunting at different times of the day. Other environmental forces such as floods, fire, habitat disturbance by man, and disease also affect prey populations at certain times, but it is the constant pressure on prey species by raptors (and other predators) that is usually the limiting factor in controlling many species.

**Predation** is a powerful force which keeps animal populations at stable levels, close to their threshold of security. This is the state in which prey numbers are reduced by predators so that the vulnerability of that species to predation is 0 or nearly so. **Vulnerability** is determined by two conditions: prey density and prey risk. Predators take prey in proportion to their relative densities. This density relationship is continually modified by risk which works together to make a species more or less vulnerable to predation than another. The risk a species runs to predation depends on many factors including protective cover, movement, concentration, habits, habitat type, size and strength, and escape reactions.

Vulnerability of a species is also influenced by the densities of other prey species, the time of the year, and by the changing raptor population. At certain times, some species which are normally vulnerable to predation become virtually invulnerable because of one of these factors. However, under most circumstances it is those species with the highest densities that are taken most frequently by predators.

Biologists who study raptor predation must examine the many factors which determine prey vulnerability as well as various aspects of the raptor population, including breeding success and food habits. Only after compiling this data and examining it as a whole can the complex interrelationship between predator and prey be seen.

Determining feeding habits of the raptor population becomes an extremely important part of studies of this kind. Although several methods of gathering data have been employed, none has proven as effective or yielded more quantitative data than pellet analysis.

Both hawks and owls consume quantities of bone, feathers, and hair when eating prey. After the bird has digested its meal, this inert, undigestible material is rolled and compacted in part of the raptor's digestive tract to form what is called a pellet of casting. This is regurgitated several hours after feeding or before the next meal. It isn't known how many pellets a wild raptor produces per day so that accurate figures on daily intake are unavailable. However, they do yield information as to the type of prey consumed. By comparing bones, feathers, and hair with the same material in an identified collection, identification of the dissected items is fairly easy. In many cases, if a large enough sample of pellets is examined, it is possible to obtain a fairly accurate record of the diet of one raptor or the diet of a species. It is also an indication of population densities and vulnerability of the prey species identified.

Accuracy in making counts of prey items depends on the type of pellet that is being worked with. Because of differences in feeding habits and physiology, hawks and owls produce pellets that differ in their ability to be examined quantitatively. Owls tend to swallow small prey whole and larger prey in several pieces. They don't take the time to pluck their prey. Also their digestive tract does little or no damage to the bone consumed. This results in pellets that usually contain whole skeletons that are relatively undamaged. Hawks, on the other hand, pluck their prey before eating and then tear it into small pieces before swallowing, consuming varying amounts of fur or feathers. They also digest bone more completely than owls so that their pellets often contain little osseous remains. Identification of prey species must be made by pairing incisors which are usually present. Fairly accurate counts can be made in this manner by someone trained in their identification.

It can be expected therefore that the number of individual prey items found in owl pellets more closely represents the actual number consumed than it does in hawk pellets. Other factors, such as the number and size of species represented and the durability of the pellet help in making accurate counts of prey items. Pellets that contain only a few species and that do not break apart upon impact with the ground can be analyzed far more accurately than a pellet that contains numerous species and breaks easily (resulting in recovering only part of the pellet).

Barn owl pellets, because of the combination of little bone digestion, pellet durability, and the limited number of small-sized prey species yield very accurate data which the student can interpret.

— from Connecticut Valley Biological Supply Co., Inc.

## LESSON TWO: "Wonder Egg"

Note to Teacher:

It is highly recommended that Lessons Two and Three be taught concurrently.

**TIME:** one 45-minute class and 10 minutes for 3 to 5 days thereafter



**OBJECTIVE:** The Student will:

1. Observe and record the process of demineralization of an egg which is similar to bone.

### VOCABULARY:

acetic acid: scientific name for the weak acid found in vinegar

demineralize: to remove the mineral matter from a substance

opaque: does not transmit light through an object

translucent: transmits and diffuses light so that objects beyond cannot be seen clearly

transparent: transmits light so that objects beyond can be seen clearly

### MATERIALS AND EQUIPMENT:

one raw egg per group

one transparent 500 ml container per egg

white vinegar, enough to cover each egg (approx. 300 ml per egg)

plastic wrap

rubber bands (one per group)

Lab Sheet B-2A

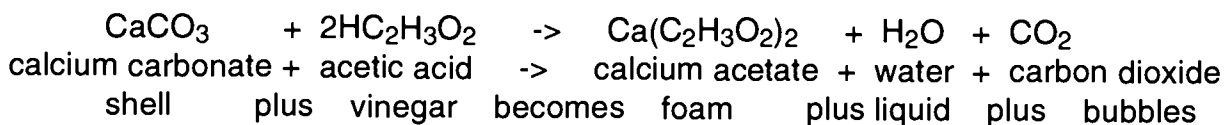
### PREPARATION:

1. Duplicate Lab Sheet B-2A, one per student.
2. Determine storage location for eggs in containers.

### PROCEDURE:

1. Distribute all materials and lab sheet to class.
2. Complete Lab Sheet B-2A.

Note to Teacher: Balanced chemical reaction:



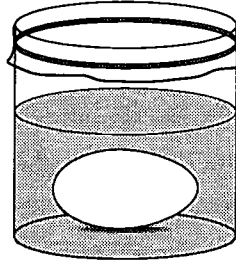
### EVALUATION:

1. Completion of Lab Sheet B-2A.
2. Discussion of hypotheses and conclusions.

NAME: \_\_\_\_\_

# WONDER EGG

1. Weigh and measure egg.
2. Place a whole raw egg into a transparent container and cover it with white vinegar (which contains acetic acid).



3. Cover the jar with plastic wrap and place it somewhere where it will not be disturbed.
4. What do you think will happen to the egg over time?  
Write your hypothesis here:

5. Record your observation of the egg here:

Day 1:

Day 2:

Day 3:

Day 4:

Day 5:



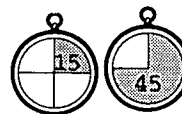
6. At the conclusion of this experiment, weigh and measure the egg.
7. Did you prove or disprove the above hypothesis?

### LESSON THREE: "Calcium and Collagen"

**TIME:** one 15-minute period for introduction of lesson and one 45-minute class

**OBJECTIVE:** The Student will:

1. Observe the role of calcium and collagen in the bone.



#### VOCABULARY:

acetic acid: scientific name for the weak acid found in vinegar

calcium: a soft, white mineral substance which aids in building bones.

collagen: the connective tissue made of protein found in bones

demineralize: to remove the mineral matter from a substance

elasticity: the capacity of a strained body to recover its size and shape after deformation

#### MATERIALS AND EQUIPMENT:

two cooked chicken bones per group (preferably leg or thigh bone)

white vinegar, enough to cover bones (200 ml per bone)

one transparent 500 ml container per bone

plastic wrap to cover container (if desired)

Lab Sheets B-3A, B-3B, and B-3C

Self-cleaning oven

Optional:

sodium hydroxide (lye)

#### PREPARATION:

1. Obtain necessary materials.
2. Duplicate Lab Sheets B-3A, B-3B, and B-3C, one each per student.

Optional:

3. To decollagenize bones, obtain sufficient sodium hydroxide (lye solution). Due to the caustic nature of lye, full laboratory precautions are necessary. Dispose down sink with plenty of water. Before handling bones, rinse them well under running water.

#### PROCEDURE:

1. Divide students into small groups.
2. Distribute materials and lab sheets to each group.
3. Complete hypotheses on Lab Sheets B-3A and B-3B.
4. Demineralize one bone per group, and decollagenize one bone per group following the procedure on Lab Sheets B-3A and B-3B.
5. Place bones and containers where they will not be disturbed.
6. When bones are demineralized/decollagenized, complete the remainder of Lab Sheets B-3A and B-3B.
7. Complete Lab Sheet B-3C.



**EVALUATION:**

1. Completion of Lab Sheets B-3A, B-3B, and B-3C.

**RESOURCES:**

1. grocery store
2. Parker S, Skeleton, Eyewitness Books, Knopf Pub., NY, 1988.

NAME: \_\_\_\_\_

# THAT'S THE BREAKS

## Removal of Calcium

**HYPOTHESIS:** (Make a reasonable guess about what happens when you remove calcium from a bone.)



**PROCEDURE:** Place a chicken bone or bones into a container and cover with white vinegar. Cover the container top with plastic wrap and place the bones where they will not be disturbed. In a few days, remove the bone(s) and attempt to break them.

**OBSERVATION:** (What did you see ?)

**RESULTS AND DISCUSSION:** (What happened? Why?)

**CONCLUSION:**

(Did you prove or disprove the above hypothesis? Explain why or why not.)

NAME: \_\_\_\_\_

**THAT'S THE BREAKS****Removal of Collagen**

**FACT:** Collagen can be removed from bones by applying heat.

**HYPOTHESIS:**

(Make a reasonable guess about what happens when you remove collagen from a bone.)

**PROCEDURE:**

Place chicken bone(s) in a self-cleaning oven and set for one cleaning cycle.

**OBSERVATION:** (What did you see?)

**RESULTS AND DISCUSSION:** (What happened and why?)

NAME: \_\_\_\_\_

**THAT'S THE BREAKS**

In short sentences, describe how each of the objects listed below may have similar characteristics to a bone.

1. Toothbrush
2. Pickle
3. Popsicle stick
4. Rubber band
5. Chalk
6. Leg of your school desk/table
7. Pencil eraser
8. Straw
9. Ruler
10. Aluminum pop can

## LESSON FOUR: "If It Ain't Broke..."

Note to Teacher: Following a fracture, there are the usual reactions of any tissue to severe injury. The rupture of blood vessels in the bone marrow and in the periosteum causes the development of a large bruise, or layering of blood around the fracture, with the bleeding extending into the bone marrow and the surrounding soft tissues. Replacement of the blood clot by young connective tissue (granulation tissue) results in the formation of the procallus. The primary function of granulation tissue is to remove and replace dead tissues.

The granulation tissue becomes dense connective tissue (fibroblasts) as collagenous fibers, forming the fibrocartilaginous callus (soft bone). The new bone originates from the deeper layers of the periosteum, the soft bone being replaced by new bone, the bony callus (hard bone).

**TIME:** one 45-minute class



**OBJECTIVES:** The Student will:

1. Develop classifications of different types of broken bones;
2. Describe the continuous process of absorption and resorption;
3. Explain the significance of growth plates and how they may be affected by a fracture; and
4. Diagram and label the mending process of a broken bone.

### VOCABULARY:

absorption: the process of taking in dietary minerals to build and maintain bone tissue

collagen: the connective tissue made of protein, found in bones

compound fracture (open): a fracture in which there is an external wound leading to the break of the bone

distal: located away from the center of the body

fissure: a crack extending from a surface into, but not through, a long bone

growth plate: the sensitive sites where bone growth occurs throughout the body

osteoblast: cells that make new bone material by hardening the protein collagen with minerals

osteoclast: cells that dissolve bone material, releasing the minerals into the blood

proximal: located toward or near the center of the body

resorption: a type of bone loss due to osteoclastic activity

simple fracture (closed): a fracture that does not produce an open wound in the skin

stress fracture (fatigue): a fracture attributed to the strain of prolonged running or other exercise

### MATERIALS AND EQUIPMENT:

Lab Sheet B-4A

Information Sheet B-4B

### PREPARATION:

1. Duplicate Lab Sheet B-4A and Information Sheet B-4B, one per student.

**PROCEDURE:**

1. Initiate discussion about students' broken bones.
2. Read and discuss Information Sheet B-4B.
3. Complete Lab Sheets B-4A.

Optional:

4. Students will design a poster illustrating one of the various bone strength facts.

**EVALUATION:**

1. Completion of Lab Sheet B-4A.

Optional:

2. Completion of poster.

**RESOURCES:**

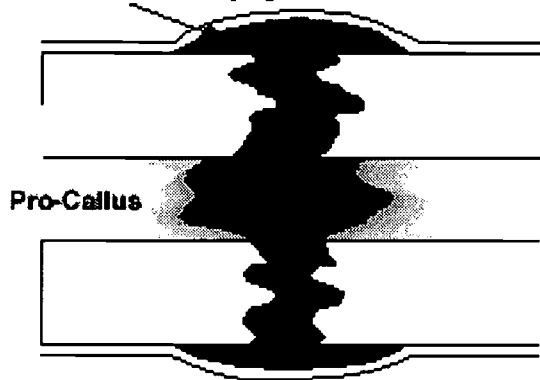
1. Parker S, Skeleton, Eyewitness Books, Knopf Pub., NY, 1988.
2. Cooper K, Kid Fitness, Bantam Books, NY, 1991.
3. National Osteoporosis Foundation, Boning Up on Osteoporosis, 1991. 1-800-223-9994.
4. "Fractures," American Academy of Orthopedic Surgeons, 222 S. Prospect Avenue, Park Ridge, IL 60068.
5. school nurse
6. individual students' x-rays
7. orthopedic surgeons/family physicians
8. "Bones and Joints." AAY5983. 1995 Films for the Humanities and Sciences. P.O. Box 2053, Princeton, NJ 08543-2053. 1-800-257-5126. Fax# 609-275-3767.
9. "Bones, Cartilage and Joints". AAY4159. 1995 Films for the Humanities and Sciences. P.O. Box 2053, Princeton, NJ 08543-2053. 1-800-257-5126. Fax# 609-275-3767.

# BONE HEALING PROCESS

## Step-by-Step

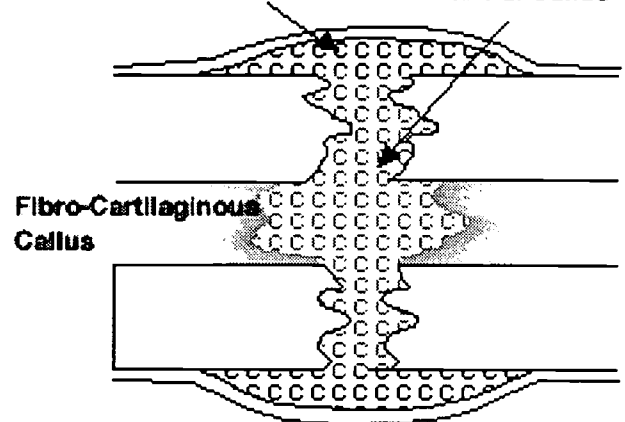
### Step #1

Hematoma--coagulates  
6-8 hours after injury



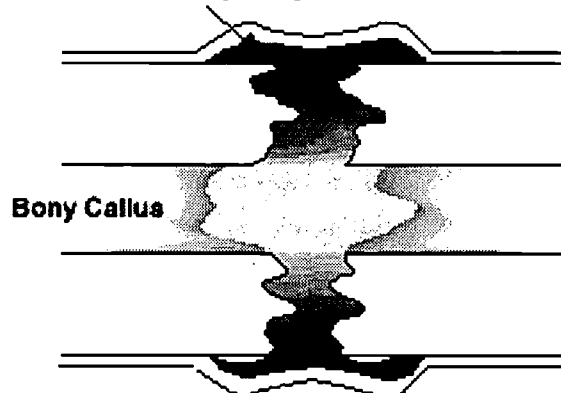
### Step #2

External Callus      Internal Callus



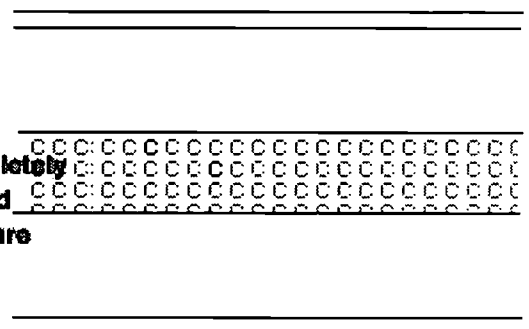
### Step #3

New bone originates  
from the deeper layers.



### Step #4

Completely  
Healed  
Fracture



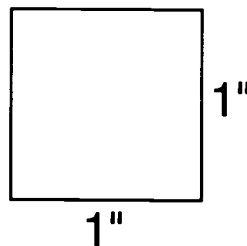
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Lab Sheet B-4B

### Student Information Sheet

## BONE STRESS

Compact bones such as the thigh's femur can support more weight than granite or reinforced concrete (steel cables are embedded in concrete for additional strength). When pulled end from end (tensile strength) bone endures forces of 10,000 to 20,000 pounds per square inch! This is about the same as the weight of eight small cars pulling on an area this size:



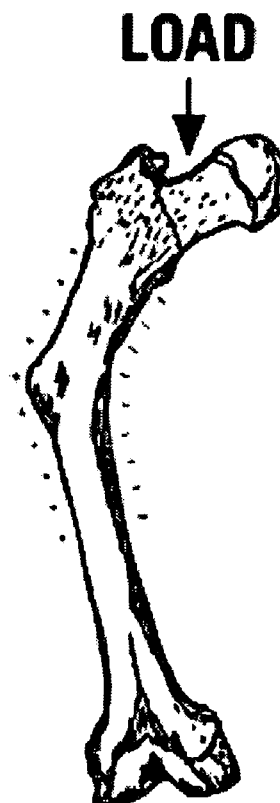
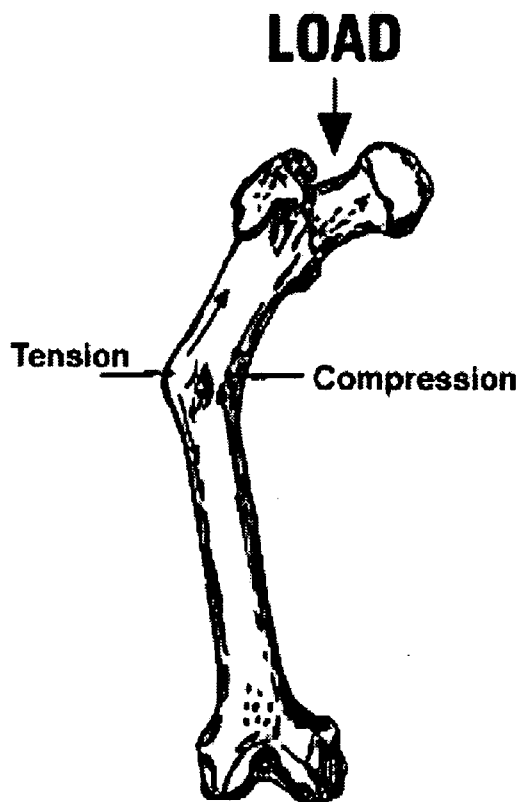
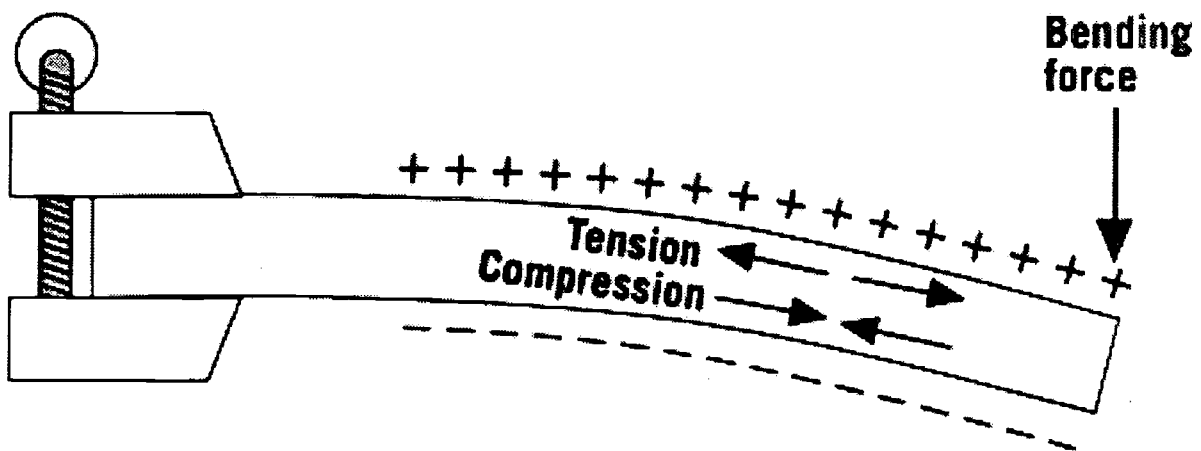
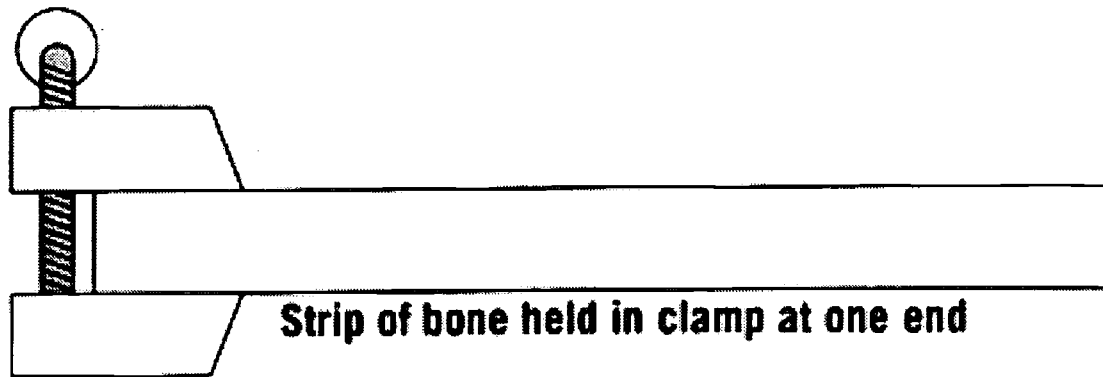
Compact bone has about the same strength as pure iron.

Bones need to be light so that they do not damage the surrounding human tissue. The skeleton of a 160-pound person weighs about 29 pounds. A skeleton of the same strength, made of steel, would weigh up to 145 pounds!

Bones are composed of mineral crystals (mainly calcium and phosphorus) and collagens (fibrous proteins). After the minerals are removed from the bone, the collagen is very flexible. It can even be tied into a knot. Bones would be too brittle to support our bodies without the presence of collagen.

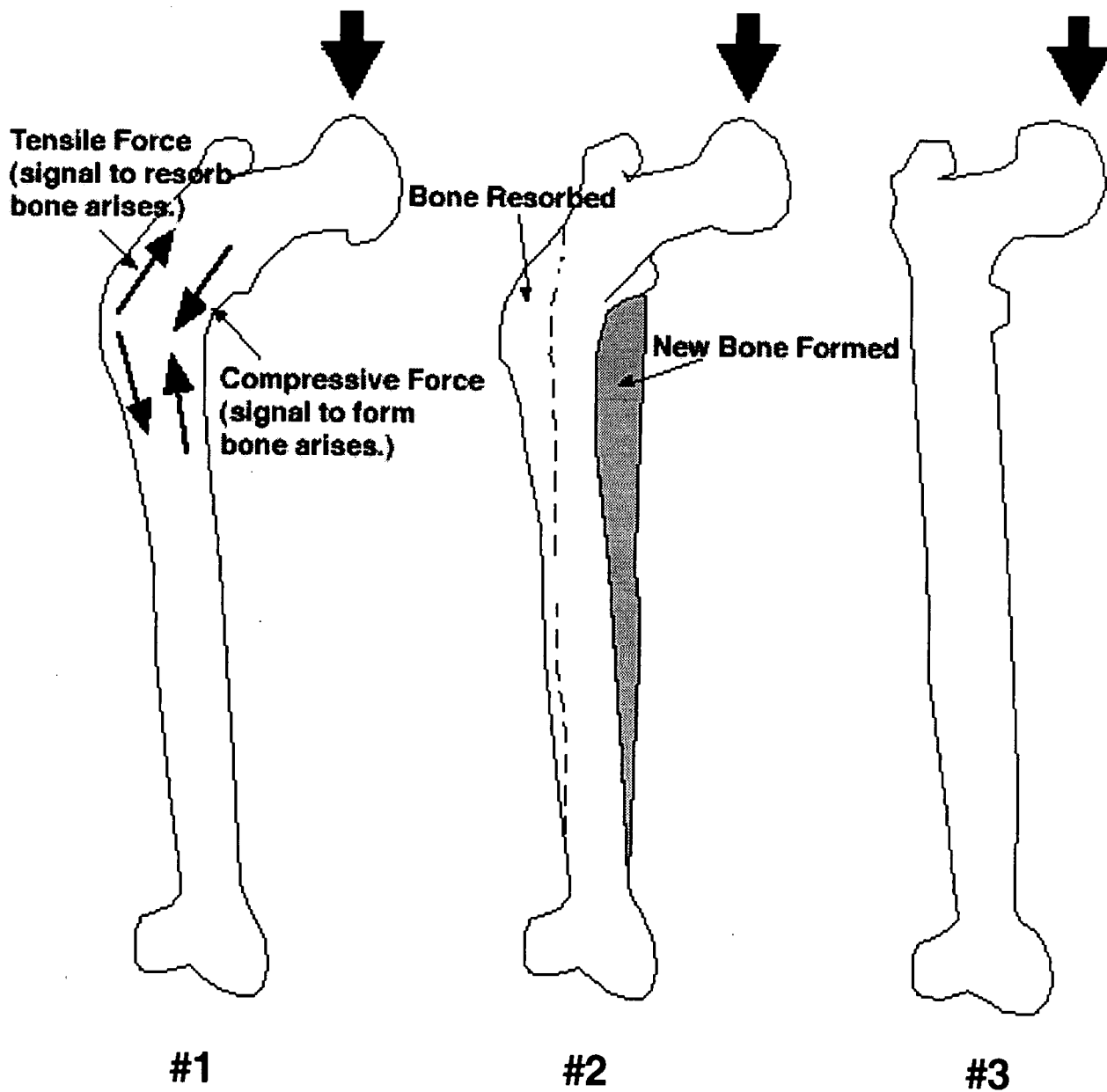
The balance of minerals and collagen give the bone remarkable strength. Bones have the ability to endure the pressure and stress of routine physical exercise. A sit-up places as much pressure on the lower spine as deep sea divers feel at 570 feet below the surface (270 pounds/square inch). A high jumper puts 20,000 pounds of stress on his/her femur when he/she lands. This is about as much stress as the weight of eight small cars. The bones of the feet support a person's total body weight on an average of 19,000 steps each day.

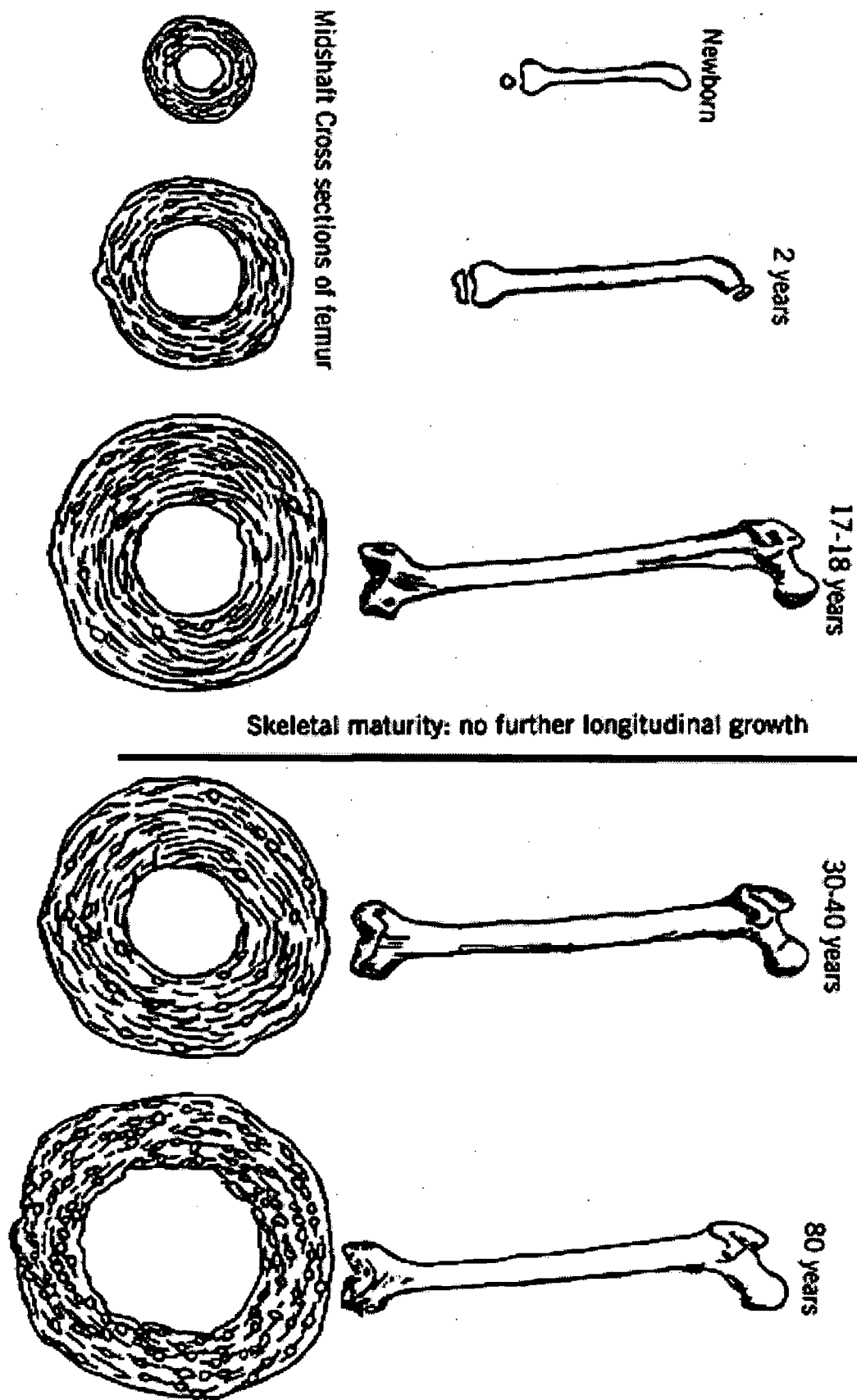




# Bone Remodeling in Response to Stress

## Direction of Stress

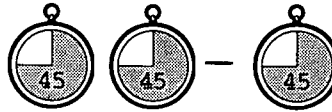




Skeletal maturity: no further longitudinal growth

## LESSON FIVE: "Parts Are Parts"

**TIME:** two to three 45-minute classes



**OBJECTIVES:** The Student will:

1. Observe and label the external and internal composition of bone.

### VOCABULARY:

dissection: the act of separating objects into pieces for scientific study

femur: the proximal bone of the hind or lower limb (thigh bone)

horizontal: parallel to a baseline of horizon

vertical: perpendicular to the horizon

### MATERIALS AND EQUIPMENT:

8 1/2 X 11" plain white paper for sketches, one sheet per student  
 ample newspapers to cover tables  
 dissection kit (forceps, scissors, knife, and dissecting probe)  
 3 cow femurs  
 microscopic slides, cover slips, lens paper, and medicine droppers  
 magnifiers  
 colored pencils or markers  
 microscope or bioscope  
 disposable gloves  
 plastic bags for waste removal  
 Lab Sheets B-5A and B-5B  
 Optional:  
 Lab Sheets B-5C and B-5D.

### PREPARATION:

1. Obtain bones 24 hours prior to dissection. Ask butcher for clean cow femurs: minimum of one whole, and two cut in half (one showing a horizontal cross section and one showing a vertical cross section)
  2. Duplicate Lab Sheets B-5A and B-5B, one per student.
- Optional:
3. Duplicate Lab Sheets B-5C and B-5D, one per student.

### PROCEDURE:

1. Divide students into small groups.
2. Students should examine bones and bone sections.
3. Distribute lab materials and Lab Sheets B-5A and B-5B.
4. Have students remove any connective tissue (fat, cartilaginous material, or muscle) from the bone surface. Exercise extreme caution.
5. Complete Lab Sheet B-5A.
6. Students should write their reactions and comments about the activity.

**Optional:**

7. Have students prepare microscopic slides showing the anatomy of the bone: trabecular or spongy material; marrow; blood vessels; and cortical material; distribute Lab Sheet B-5C.
8. Using microscopes or bioscopes, students should observe slide samples they have prepared.
9. Clean up lab materials and wash hands thoroughly.
10. Students will diagram/illustrate microscopic slides.
11. Test on bone diagram, Lab Sheet B-5D.

**EVALUATION:**

1. Completion of Lab Sheet B-5A.
2. Completion of written comments/reactions.

**Optional:**

3. Completion of bone diagram test (B-5D).
4. Proper slide preparation technique.
5. Completion of illustrations of microscopic slides.

**RESOURCES:**

1. local meat department or butcher shop
2. Parker S, Skeleton and Movement, Franklin Watts Pub., NY, 1989, p.9.
3. "Bones and Joints." AAY5983. 1995 Films for the Humanities and Sciences. P.O. Box 2053, Princeton, NJ 08543-2053. 1-800-257-5126. Fax# 609-275-3767.
4. "Bones, Cartilage and Joints". AAY4159. 1995 Films for the Humanities and Sciences. P.O. Box 2053, Princeton, NJ 08543-2053. 1-800-257-5126. Fax# 609-275-3767.
5. "Accident". AAY4159. 1995 Films for the Humanities and Sciences. P.O. Box 2053, Princeton, NJ 08543-2053. 1-800-257-5126. Fax# 609-275-3767.

NAME: \_\_\_\_\_

Lab Sheet B-5A

# PARTS ARE PARTS

## Observation of Bones

	Texture	Color	Hardness	Comments
whole femur				
vertical cross section				
horizontal cross section				

Look at the whole femur. Compare the surface at the ends of the bone with the mid section. Why do you think these different surfaces exist? Sketch the bones you have been working with today. Be as detailed in your drawing as possible; use colored pencils.

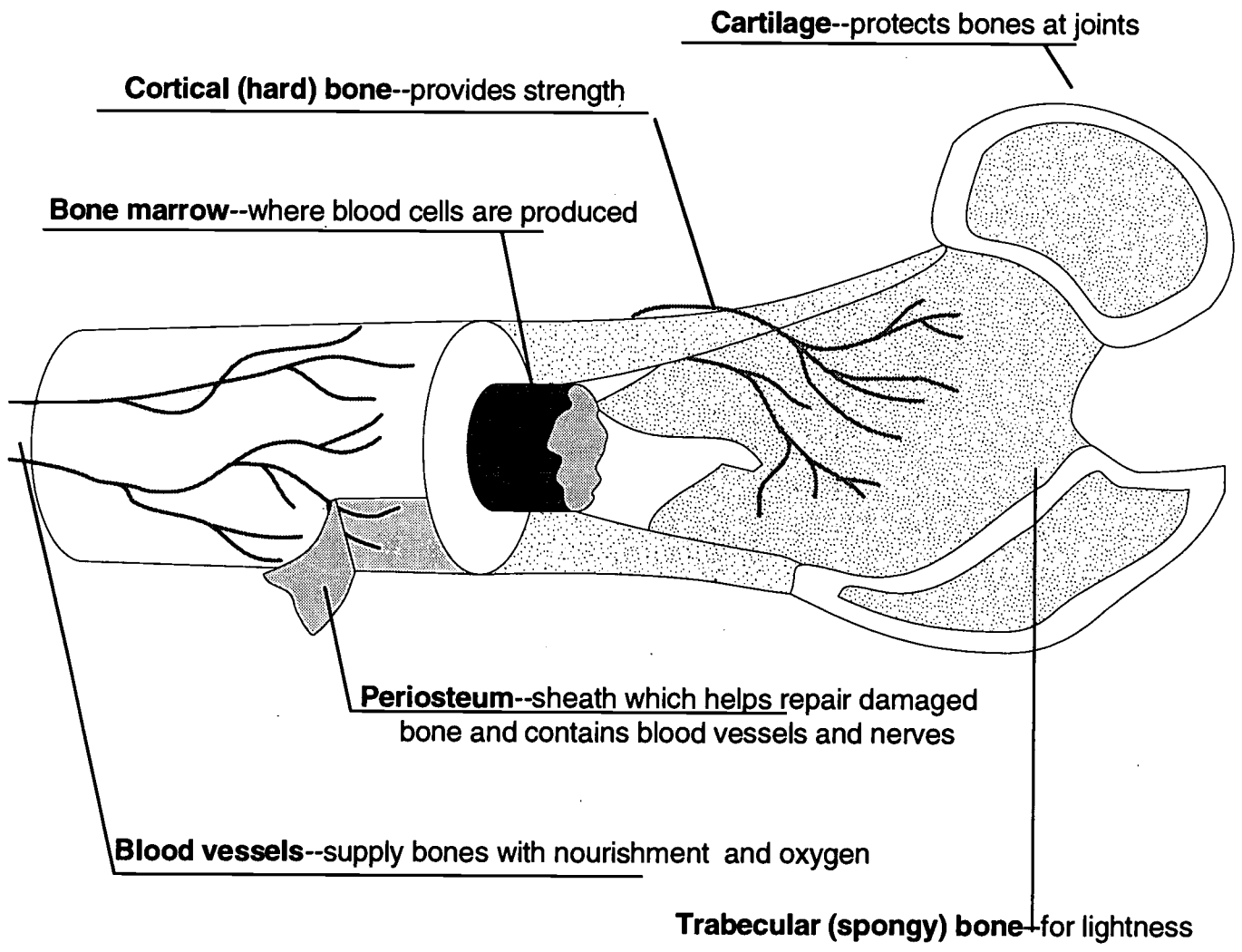
Whole femur

Vertical Cross Section of femur

Horizontal Cross Section of femur

Explain at least two things that you learned from dissecting the bone that you did not already know.

# FEMUR CROSS SECTION

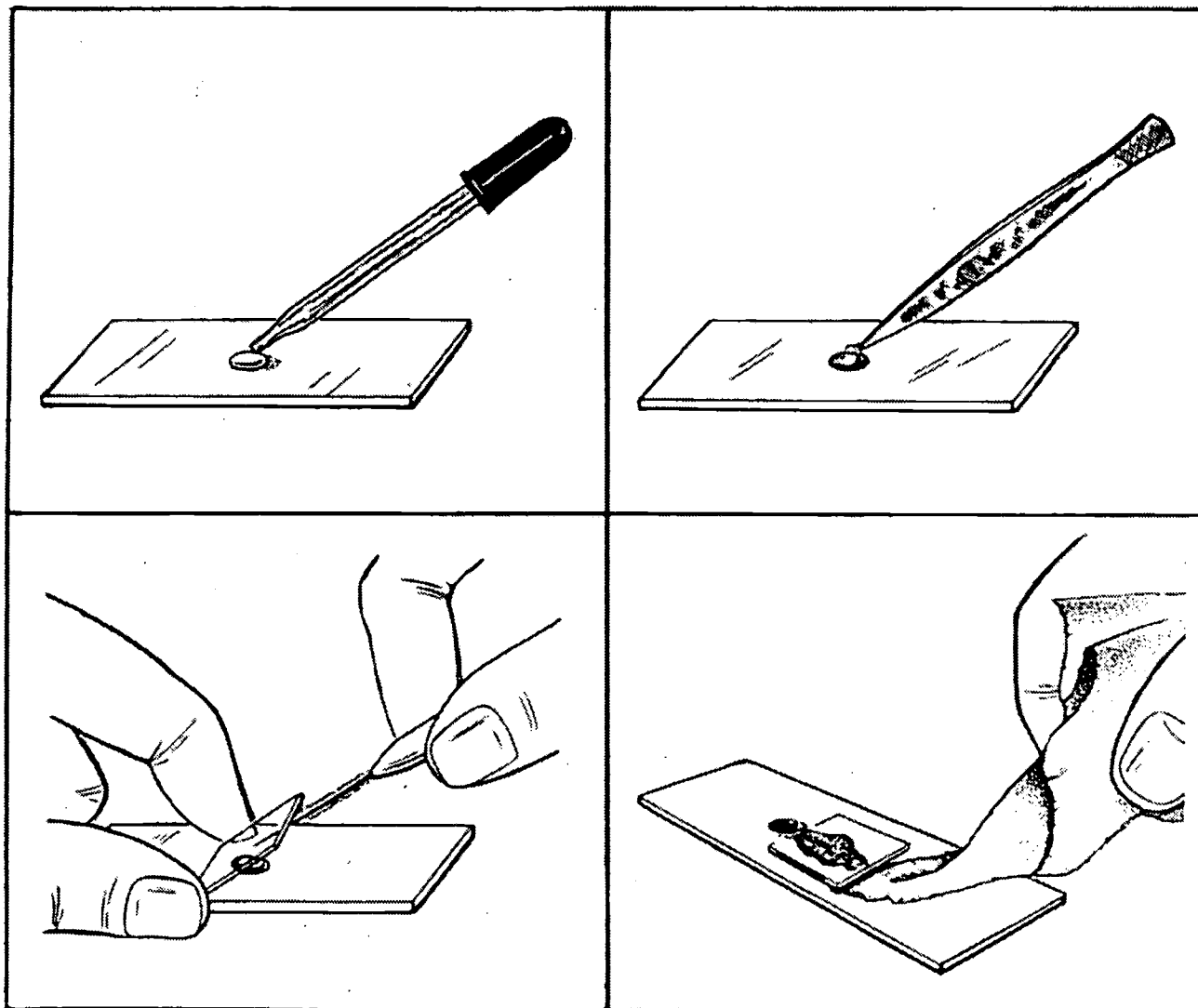


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## SLIDE PREPARATION

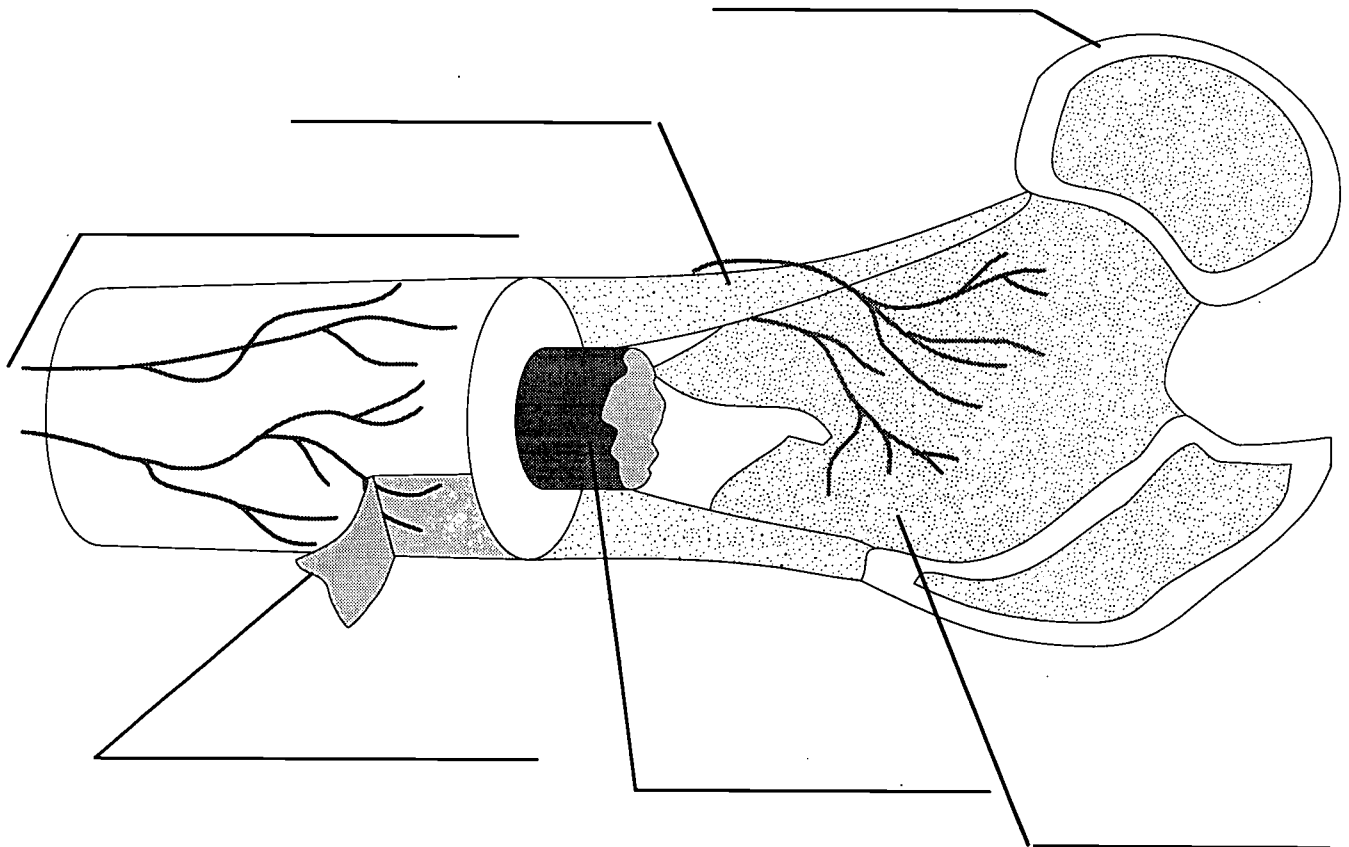
Clean a microscope slide thoroughly with a soft lint-free cloth or a piece of lens paper. Handle the slide and the cover slip only by the edges.

- (1) Place a drop of water in the center of the slide with a medicine dropper.
- (2) Place the specimen in the drop of water.
- (3) Holding the cover slip at an angle, carefully lower it over the specimen. Do not press down on the coverslip.
- (4) A slide prepared by this method is called a wet mount.





## BONE DIAGRAM TEST



Label the bone diagram above with these terms:  
Can you describe what these parts of the bones do?

1. Periosteum
2. Trabecular bone
3. Bone marrow
4. Blood vessels
5. Cortical bone
6. Cartilage

## LESSON SIX: "When Bones Get Brittle"

Note to Teacher: Because it is generally accepted that children's dietary and exercise habits can affect bone density and therefore affect their chances of having osteoporotic (porous) bones in their later years, it is important to emphasize prevention activities at this time. Portions of the booklet "Boning Up on Osteoporosis" by the National Osteoporosis Foundation are included here for your information. They may be ordered by calling 1-800-223-9994.

**TIME:** two 45-minute classes



**OBJECTIVES:** The Student will:

1. Describe the difference between normal and osteoporotic bone;
2. List at least three ways to maintain healthy bones; and
3. List the common risk factors for osteoporosis.

### VOCABULARY:

osteoporosis: a medical condition resulting in porous bones that are easily fractured

risk factor: an attribute that increases a person's chance of contracting a certain disease or condition (e.g. smoking tobacco is a major risk factor for lung cancer)

### MATERIALS AND EQUIPMENT:

Lab Sheets B-6A and B-6B

Optional:

Human Growth computer software

### PREPARATION:

1. Duplicate Lab Sheets B-6A and B-6B, one each per student.
2. See accompanying software for graphics of normal and osteoporotic bones.

### PROCEDURE: (Day 1)

1. Briefly discuss the subject of animal rights, noting that:
  - a. animals are used for medical research only when necessary, so that people will live longer, healthier lives;
  - b. scientists don't use people's pets for research, but use animals that are specifically bred for that purpose, such as rats and mice;
  - c. the laboratory animals are kept as comfortable as possible, and are sacrificed only when absolutely necessary.
2. Divide the class into small groups of 3 to 4 students; tell them, "Pretend that you are scientists (bone biologists), and the big problem in society is that there are too many older people suffering from bone fractures. Each year, over one million people in the U.S. suffer broken bones because of osteoporosis. We have an idea (hypothesis) that porous bones are a big part of the problem, and that osteoporosis may be linked to level of physical activity, intake of calcium, and heredity. Your challenge as scientists is to plan an experiment to find out if this is true." Write the words diet, exercise, and heredity on the chalkboard.
3. Allow them just 15 minutes to discuss the issue in their small groups, then ask the class

to turn their attention to you for a few minutes, as they share their ideas (hypotheses) with the class.

4. Distribute Lab Sheets B-6A and B-6B, and some graph paper (optional). Instruct them to follow the directions for the remainder of the class period.

**(Day 2)**

5. Show the pictures or software of normal and osteoporotic bones (microscopic and whole animal views), and discuss the risk factors for osteoporosis and three ways to maintain healthy bones.
6. Have one person from each group discuss their “experiments,” assuring them that this is how scientists and investigators of all kinds solve problems. It’s called the Scientific Method.

**EVALUATION:**

1. Completion of Lab Sheet B-6A. Note: As long as each group has been thinking about reasonable ways to solve the problem, consider the lab complete. It is important that they do not receive a grade for having a “wrong answer,” because it is the method of scientific inquiry that you want to encourage.
2. (Optional) Small group activity: Prevention saves money!

Each year, over one million people with osteoporosis in the U.S. break one or more bones of the hip, spine, or wrist (more than 250,000 hip fractures). In the United States, the medical, nursing home, and social costs (such as lost work time) of osteoporosis and its consequences is about 11 billion dollars (\$11,000,000,000!). If we could prevent osteoporosis in, for example, 20% of the population, how much money could be saved?

Outline a national plan for using that money to help prevent osteoporosis.

**RESOURCES:**

1. National Osteoporosis Foundation, Boning Up on Osteoporosis, and other consumer literature. Call 1-800-223-9994.
2. Primary care physician, nurse, or other health personnel who work with patients who have osteoporosis.

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NAME: \_\_\_\_\_

Lab Sheet B-6A

**The Problem:** Each year, over one million people in the U.S. break one or more bones due to osteoporosis. We have an idea (hypothesis) that porous bones are a big part of the problem, and that osteoporosis may be linked to level of physical activity, intake of calcium, and heredity.

**The Solution:** You and your fellow "think tank" partners must develop a plan to test the above hypothesis. You have only a short amount of time to discuss what and how you want to test, and then your Project Director (your teacher) will ask one of you to give a preliminary report.

Your laboratory at the National Institutes of Health is stocked with 1000 rats. They can be fed with regular lab chow pellets or high calcium lab chow pellets. They can be restricted in small cages (low activity). 750 of the rats were bred with regular bones, and 250 were bred with porous (osteoporotic) bones.

What question will you try to answer?

How will you set up the experiment?

What information (data) will you record?

(optional) Can you graph the results?

What do you think it will prove?

How will this experiment help humans?

What else can you suggest to prevent broken bones (fractures)?



NAME: \_\_\_\_\_

**Bone Facts:** Since osteoporosis is a disease of the bones, we need to discuss how bones are formed in order to understand the disease. Bone is formed when a soft protein framework (mostly collagen) becomes hard when the mineral calcium is added. About 99% of the body's calcium is stored in the bones and teeth.

Bones are not "dead," but are living, growing tissue. Throughout life, bone is constantly renewed with old bone being removed and new bone being laid down. Two types of bone are found in the body: cortical and trabecular. Cortical bone is the dense compact layer forming the outer portion of the bones. Trabecular bone, on the inside, has a porous, "honeycomb" structure. With osteoporosis, bone loss occurs at a faster rate in trabecular bone than in cortical bone. Osteoporosis usually affects the hip, spine (back), and wrist.

During childhood and adolescence, bones become larger, heavier, and denser. Peak bone mass (maximum bone density and strength) is reached between ages 25 and 35. During this time, activities such as exercise and adequate intake of calcium are thought to protect against fractures later in life. After age 35, in both men and women, bone removal is greater than bone replacement. If bones become weaker, then a person is at greater risk for developing osteoporosis. Another risk factor for osteoporosis is heredity, which means that a person's chance of getting the disease depends partly on whether or not a parent or near relative has it.

Who is at greatest risk? The cause of osteoporosis is not known. However, certain "risk factors" increase your chances of developing the disease. If you have several of these risk factors, it doesn't mean that you will definitely develop osteoporosis or have a fracture, but rather that your chances of having this happening are increased.

**Gender** - Women are four times more likely than men to develop osteoporosis than men, mainly because women have lighter, thinner bones than men.

**Age** - The longer you live, the more likely you are to develop osteoporosis, because aging bones tend to lose bone mass.

**Thin, small-framed body** - People with small frames have less bone to lose than people with large frames. Also, people who are very thin tend to break more bones than others.

**Race** - Caucasians and Asians are at higher risk of developing osteoporosis than African-Americans. Hip fractures are twice as high in white women as in black women.

**Lack of calcium** - Calcium is needed throughout life to build and maintain healthy bones. Not enough calcium will weaken the skeleton.

**Lack of physical activity** - People who are inactive are at higher risk for osteoporosis.

**Heredity** - Your chances of breaking a bone are due partly to heredity.

**Tobacco and Alcohol** - Smoking tobacco and drinking alcohol are known to be damaging to bones.

Therefore, to **maintain healthy bones:** participate in regular exercise; see that you eat enough calcium each day; be sure to take enough vitamin D (found in most milk); and avoid injuries.

## National Museum of Natural History

SMITHSONIAN INSTITUTION  
WASHINGTON, D.C. 20560

### WHAT BONES TEACH US

Collecting and studying human skeletons in museums and scientific laboratories is presently a complex, controversial subject. The purpose of this article is to explore the kinds of information scientists obtain by studying human skeletons, and how that information is used.

A physical anthropologist is trained to determine many facts about an individual from bones alone. For instance, sex identification often can be determined by the differences in the pelvis and skull. Even bone fragments may be sexed; some chemical components of bone differ between men and women. Age at the time of death can be estimated very closely by looking at the teeth and at the fusion between different parts of the same bone, especially for children and young adults. For older people, the estimates are less exact and rely more on changes in joint surfaces, fusion between skull bones, and microscopic details of internal bone structure. Height is estimated by the length of the long bones, especially the thigh. Race can often be determined by looking at characteristics of the facial skeleton. Statistical studies of tooth, skull and face shape can even distinguish closely related groups within the same major race.

The skeleton reveals information about lifestyle as well. Well-developed muscles leave their mark on bone and tell of heavy physical activity during life. Habits (such as pipe-smoking) and handedness may leave traces of teeth or in asymmetric bone and muscle development. Health, injuries, and many diseases, such as syphilis, tuberculosis, arthritis, and leprosy, may leave traces on bone. A subfield of physical anthropology, paleopathology, is devoted to the study and diagnosis of diseases in ancient human remains.

From these studies, paleopathologists are often able to provide medical insights on the history and ecology of modern human diseases. For instance, childhood illness or malnutrition can be detected by abnormalities in tooth enamel and bone mineralization. By noting the position of these abnormalities, physical anthropologists, with their knowledge of normal growth patterns of bones and teeth, can often pinpoint at exactly what age the illness or growth disturbances occurred. From this can be determined whether a child's health problems were caused by a sick or poorly nourished mother, by early weaning, or by later periods of food shortage.

#### Victim Identification

Because of their skill at piecing together an individual's life history from skeletal clues, physical anthropologists are constantly in demand to help identify humans who have been the victims of accidents or foul play. The forensic anthropologist can tell authorities if bones are human, and if disarticulated, whether or not they all come from the same individual. Today, physical anthropologists are helping Argentinean authorities locate and identify skeletons of people kid-



napped and murdered by political extremists during Argentina's period of upheaval in the past decade. Recently, anthropologists helped confirm the identification of a skeleton attributed to Nazi war criminal Josef Mengele. Other scientists use information learned from studying museum skeletons to help provide facial reconstruction of what missing children might look like several years after their disappearance.

### **Burial Remains**

Why do scientists collect and study more than one skeleton from the same site or cemetery? Isn't one enough? The answer depends on what questions the scientist wants to answer. Although a single skeleton can tell us much about an individual, that person is known only in isolation, and people don't live in isolation. To the anthropologist, much more important information about whole social groups, their history and relationships with neighboring and past cultures, their diet and health, and also their social customs and relationships can be obtained only by studying large numbers of skeletons from the same culture or living site. Such population-wide studies require many specialized analytic techniques that depend on having large numbers of observations in order to be valid.

### **The Case of the Ainu**

Many of these population studies have provided information about past human migrations, declines, and relationships that were unrecorded even in traditional stories and myths. For instance, research by anthropologists on the Ainu of Japan has resolved some long-standing questions about their origins. The Ainu are considered by most Japanese to be a low status ethnic minority whose physical features are somewhat different from the majority population. Although Japanese tradition holds that modern Japanese are descended from the prehistoric Jomon culture found throughout Japan, two studies now show that the Ainu are the true descendants of the Jomon people. According to studies of minute variations in teeth and skulls of the modern inhabitants of Japan, and of various prehistoric cultures from Japan and other parts of Asia, the modern Japanese are most likely the descendants of invaders from northern China called the Yayoi, who conquered the islands a little over 2,000 years ago. An interesting twist to the story is that many of the medieval Japanese warrior class, the samurai, show physical features that suggest that they were descendants of Jomon mercenary armies recruited by the Yayoi during their military conquest. As the samurai gained power and status, they eventually intermarried with the Yayoi ruling classes and passed on some of their typically "Ainu" facial traits into the modern upper classes of Japan. Today's Ainu are the descendants of unabsorbed Jomon populations who were pushed into increasingly marginal areas by the Yayoi-Japanese and their Jomon-derived samurai.

Similar kinds of studies have been used to provide answers to questions as diverse as how many waves of prehistoric immigrants populated Australia, how much white admixture there is in various American Indian groups, and how much intermarrying there was between Pueblo groups in the Southwest and Europeans during the contact period. Other researchers using the same techniques have been able to chart the progressive distinctiveness of American

Indian groups from other Asians and Pacific island populations to estimate when American Indian migrants first entered the Western Hemisphere and when the various tribes became separate.

### **Disease, Diet, and Demography**

Studies of cemeteries show scientists how human groups interact with their environment, and how they in turn are affected by changes in the physical world they occupy. Reconstruction of demography, diet, and growth and disease patterns help physical anthropologists understand the ecology of prehistoric groups and make some surprising discoveries about human adaptations, such as the health costs of agriculture, and the origins of some modern human diseases.

Many diseases can be diagnosed from skeletons, and it is sometimes possible to recover fossilized bacteria, and occasionally, amino acids for blood typing directly from bone. One extensive study of Grecian cemeteries from ancient to modern times traced the increase in malaria-resistant anemia (thalassemia, similar to sickle-cell anemia in Africa) in Grecian populations, and showed the effects of changes in ecology and social and economic patterns on the health and lifespan of ancient and recent Greeks. By looking at groupings of skeletons in cemeteries, the scientist was also able to reconstruct families or clans, and to show that anemic groups were more fertile than others.

Studies of skeletons can also tell what people ate, even without having any cultural information. Some techniques measure certain chemical isotopes and trace elements in ground bone. These amounts will differ, depending on the proportion of meat to vegetables in the diet, and on the type of plant foods eaten. Results have shown that in some prehistoric groups men and women had different diets, with men sometimes consuming more meat and women eating more plant foods. Other studies have shown that different diets leave different microscopic scratch patterns of tooth surfaces, and several kinds of prehistoric diets can be distinguished in this way.

Changes in diet often cause changes in health, which can be seen in the skeleton. The shift to maize in the prehistoric Southwest coincided with an increase in porous bone in skeletons, a sign of iron deficiency anemia. In maize farmers from Dickson Mounds, Illinois, defects in tooth enamel, which are caused by stress during childhood, are more numerous. Infant mortality was also higher, and adult age at death lower than in pre-agricultural groups. Similar studies of Hopewell mounds concluded that the agricultural Hopewell had more chronic health problems, dietary deficiencies, and tuberculosis than pre-agricultural groups. Agriculture is usually thought to bring an improvement in quality of life, but the surprising conclusion that prehistoric agriculture marked a decline in general health in the New World has been confirmed by many other studies.

### **Recent Population Studies**

Studies of human skeletons can be useful even for recent populations, when written records



are limited or have been lost. Several studies have reconstructed the living conditions of African-Americans both during and after the end of slavery. Skeletons recovered from an 18th century New Orleans cemetery showed many differences in nutrition and physical stress between urban and rural slaves. Skeletons from a late 19th-early 20th century cemetery in Arkansas open a window on this period, which is not well documented by other historical sources. Researchers concluded that men commonly left the community (there were few male burials), and that some of the community intermarried with the local Indian population. On the whole, the population was poorly nourished and had low resistance to disease. Many infants died at birth of widespread bacterial infections. Children's skeletons show dietary deficiencies and chronic infections, with many dying at 18 months, the weaning age. Iron deficiency anemias were common, probably due to corn-based diets; high levels of arthritis indicate heavy physical labor; and many signs of injuries on male skeletons may be evidence of high levels of interpersonal violence. Even without written records, the skeletons in this Post-Reconstruction community tell us of continual malnutrition, poor health, and levels of physical stress, which even exceeded those found in some communities during slavery.

### Ancient Diseases in Contemporary Populations

Physical anthropologists find many contemporary diseases in earlier human populations. Some show peculiar distributions in the United States today, which can sometimes be tied to disease prevalence in the past. One of these is osteoporosis, a weakening of bone due to a calcium-poor diet and low bone mass resulting from low exercise levels during life. This condition afflicts primarily elderly white females, leading to spontaneous fractures and spinal deformities. Surprisingly, anthropologists have discovered that osteoporosis is common in living and prehistoric Eskimos of both sexes, and appears at an earlier age when compared to American whites. However, fractures and spinal problems have not been common in Eskimo populations. In spite of the traditional calcium-poor Eskimo diet, vigorous exercise results in heavier bones that protect the individual in old age. Now however, increased lifespan and alterations in lifestyle may contribute to a rise in osteoporotic bone disorders in Arctic populations in the future.

Evidence of a disease in prehistory is sometimes useful in understanding its cause. Osteoarthritis is often found in prehistoric skeletons. Changes in the locations and numbers of joints affected, and in the proportions of men and women afflicted, have suggested that systemic factors affecting only one sex may be involved in the severity of modern arthritis, an insight that may help focus further research efforts. Studies of prehistoric skeletons have shown that high levels of tooth decay are typical only of agricultural populations. This has led to the observation that sticky carbohydrates common to most agricultural diets have something to do with the epidemic of tooth decay modern populations are experiencing. But mineral deficiencies may also be involved, as some high levels of cavities and periodontal disease have been found in non-agricultural prehistoric Illinois Indians. Since the mineral content of ground water would affect the disease resistance of tooth enamel, such studies pointed to mineral supplementation of drinking water as a means of combating tooth decay. Tuberculosis has been found in skeletons as early as 5000 years B.C. in the Old World and by at least A.D. 1000 in the New World. It is associated with keeping livestock and living in sedentary or urban

centers. Cemetery studies in Europe have shown a curious relationship between tuberculosis and leprosy, also a very ancient disease. Skeletons rarely show signs of both diseases, and as tuberculosis became more common in Europe in the late Middle Ages, signs of leprosy in European skeletons declined. Medical researchers now speculate that exposure to tuberculosis provides individuals with some immunity to leprosy.

Some health problems are more common in Native Americans than in the general population. One of these is rheumatoid arthritis, which had been thought to be a recent disease possibly caused by an infection. The discovery of rheumatoid-like lesions in prehistoric American Indians has changed the focus of medical research on this disease. Another condition more common than expected in some Native American tribes is the cleft palate/cleft lip complex of congenital bone defects. Clefting of the face has been found in prehistoric skeletons from the same region, though it is not as common as in the modern population. It is not known whether this shows a real increase in the problem, or if burials of prehistoric babies who died from their condition are simply not recovered as often as adults. Some researchers speculate that the increase, if real, might be the result of more inbreeding in tribal populations than would have occurred in the past, after groups were confined on reservations, and traditional migration and marriage patterns were disrupted.

### **Patterns of Social Organizations**

It might seem surprising that we can learn much about the patterns of political and social organization of past cultures from a study of bones, but in fact physical anthropologists and archaeologists can discover a great deal about social customs in prehistory through studies of cemeteries. This is only possible, however, with data about age and sex of each burial.

Evidence of status and marriage patterns are often visible in cemetery populations. Anthropologists studying skeletons from the prehistoric North American site of Moundville, Alabama, reconstructed three different status groups in Moundville society. These included individuals whose remains were either used as trophies, or were possibly sacrifices sanctifying the mound-building process, an intermediate group containing both men and women, and a high-status group composed entirely of adult men. By analyzing genetic differences among men and women in the same cemetery, it is often possible to reconstruct marriage and residence patterns. For instance, in one study of prehistoric and historic Pueblo cemeteries, women in each cemetery had very similar genetic markers, while the men in each group were quite variable for those same traits. This indicates that women lived and were buried with their kin groups, while men lived and were buried with unrelated groups. The ancient Pueblo people were matrilineal, just as the modern tribes are today. Some studies have revealed a relationship between an individual's status during life, and his or her physical characteristics, such as height. Taller people tend to have higher status markers in their graves in several prehistoric cultures. This is more often true for men, but in some groups taller women also had higher status. By studying skeletons for indications of growth disturbances and disease, scientists can sometimes tell whether the greater height of high status people was due to better diet and more resources, or whether they were just genetically predisposed to be taller.

## **Conclusion**

The above examples show how anthropologists can learn about many facets of the lives of individuals and communities of past cultures by studying the skeletal materials. The study of modern, historic, and prehistoric skeletons has made it possible for anthropologists to contribute an enormous and diverse array of information about human behavior and morphology past and present. None of these studies could have been accomplished without thorough study of human skeletons. To obtain this information, scientists commonly use techniques that were unheard of and unanticipated even a generation ago. It is certain that many more new approaches to reconstructing past lives from bones will be discovered in the future. Many collections may be studied and restudied, in the quest for new answers to old questions, or for answers to new questions altogether.

Prehistoric populations left us little of their history and experience from which to learn. By careful study of their skeletons, we gain an understanding of ancient humans that would not otherwise be possible. The late J. Lawrence Angel, a noted Smithsonian physical anthropologist and forensic expert, always kept a sign in his laboratory: "Hic locus est ubi mortui viventes docent." In this place, the dead teach the living. They teach us about the past, and if we listen carefully, about the future as well.

### **Recommended Reading:**

Brothwell, D.R. *Digging Up Bones*. 3rd ed. Ithaca, NY: Cornell University Press, 1981.

Ubelaker, D.H. *Human Skeletal Remains*. 2nd ed. Washington, DC: Taraxacum, 1989.

Wells, Calvin *Bones, Bodies, and Disease*. New York: Praeger, 1964.

## RESOURCES FOR MODULE 2: BONE COMPOSITION

### Strongly Recommended:

Bumie D, Birds, Eyewitness Books, Knopf Pub., NY, 1988. ISBN0-3948-9619-X.

Cooper K, Kid Fitness, Bantam Books, NY, 1991. ISBN 0-5530-7332-X.

"Fractures," American Academy of Orthopedic Surgeons, 222 S. Prospect Avenue, Park Ridge, IL 60068.

National Osteoporosis Foundation, Boning Up on Osteoporosis, 1991, and other consumer literature. Call 1-800-223-9994.

Parker S, Skeleton, Eyewitness Books, Knopf Pub., NY, 1988. ISBN 0-3948-9620-3.

Rainbow Educational Video, Our Flexible Frame: The Skeletal and Muscular Systems, 170 Keyland Ct., Bohemia, NY 11716, 1989. 1-800-331-4047.

grocery store, school nurse, orthopedic surgeons, family physicians.

### Other Resources:

Bishop P, Exploring Your Skeleton, Franklin Watts, NY, 1991. ISBN 0-531-10970-4.

"Bones and Joints." AAY5983. 1995 Films for the Humanities and Sciences. P.O. Box 2053, Princeton, NJ 08543-2053. 1-800-257-5126. Fax# 609-275-3767.

"Bones, Cartilage and Joints". AAY4159. 1995 Films for the Humanities and Sciences. P.O. Box 2053, Princeton, NJ 08543-2053. 1-800-257-5126. Fax# 609-275-3767.

Cooper K, Preventing Osteoporosis, Bantam Books, NY, 1989. ISBN 0-553-05335-3.

Grant L, Discovering the Science of Skeletons, Addison-Wesley, Reading, MA, 1991. ISBN 0-201-63237-3.

Ohio Health Promotion Network, Bureau of Health Promotion and Education, Ohio Department of Health, P.O. Box 118, Columbus, OH 43266-0118. (614) 644-7852. Various educational materials.

Parker S, The Skeleton and Movement, Franklin Watts, NY, 1989. ISBN 0-531-24606-X.

Saunderson J, Muscles and Bones, Troll Associates, Mahwah, NJ, 1992. ISBN 08167-2089-4.

Stein S, The Evolution Book, Workman Pub., NY, 1986. ISBN 0-8948-0927-X (for cleaning animal skeletons from the wild).

"Accident". AAY4159. 1995 Films for the Humanities and Sciences, P.O. Box 2053, Princeton, NJ 08543-2053. 1-800-257-5126. Fax # 609-275-3767.

## MODULE 3: NUTRITION

In this module the Student will:

Lesson One:

- (a) Collect data on actual serving size.
- (b) Compare recommended serving size to actual serving size.

Lesson Two:

- (c) Use a kilocalorie chart to determine daily intake.
- (d) Compile and complete a sample food log by recording food intake by serving size.

Lesson Three:

- (e) Compare food intake with recommended Food Pyramid.
- (f) Categorize food labels to construct a proper Food Pyramid.

Lesson Four:

- (g) Record daily activities to compute kilocalorie expenditure.

Lesson Five:

- (h) Compare and contrast a daily intake versus energy expenditure, completing a self-assessment of the results.
- (i) Suggest a positive change for improvement in lifestyle.

Lesson Six:

- (j) Develop a timeline illustrating the changes in the perception of the "ideal" body image over the years.
- (k) Summarize societal pressures to be the "ideal" body shape.
- (l) Identify the dangers of restrictive dieting and meal skipping.

Lesson Seven:

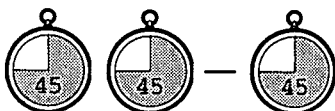
- (m) Describe the importance of adequate calcium intake in the prevention of osteoporosis.
- (n) Identify foods which are good dietary sources of calcium.

Lesson Eight:

- (o) Collect data on food water content.
- (p) Record daily activities and calculate actual water loss.
- (q) Determine optimum water intake for oneself.

## LESSON ONE: "Serve It Up"

**TIME:** two to three 45-minute classes



**OBJECTIVES:** The Student will:

1. Collect data on actual serving size; and
2. Compare recommended serving size to his/her actual consumer serving size.

### **VOCABULARY:**

serving size: an arbitrary helping of food or drink

### **MATERIALS AND EQUIPMENT:**

balance scale

food labels with serving sizes (students may bring these from home) **These labels must be saved for future lessons.**

variety of foods (e.g. cereal, potato chips, vegetables, peanut butter, juices, bread)

food service gloves

### **PREPARATION:**

1. Obtain a variety of foods and food labels showing serving size.
2. Decide whether Procedure A or Procedure B is most appropriate for your class.

#### **Procedure A:**

1. Ask students the following questions:  
If you're eating potato chips, how many do you eat in one sitting?  
Would you consider this your serving size?  
Do you feel that the serving size as stated on the bag of potato chips is the same as the amount that you normally eat?
2. Distribute one manufacturer's serving size of a chosen food to each student.
3. Discuss the students' reactions to the serving size they were given.
4. Ask the students how the portion they would choose would vary from what they were given. Discuss.
5. Have students write a brief paragraph discussing the discrepancies between the manufacturer's stated serving size and the student's actual serving size.

#### **Procedure B:**

1. Ask students the following questions:  
If you're eating potato chips, how many do you eat in one sitting?  
Would you consider this your serving size?  
Do you feel that the serving size as stated on the bag of chips is the same as the amount that you normally eat?
2. Distribute food product labels showing serving size; compare recommended serving size to the actual amount student selected.
3. Choose a group of five students to represent the class. While wearing food service gloves, allow five students to select their serving portion from the bag of potato chips.

4. Record on the chalkboard the number of chips selected per student and the ounces of chips in that selection.
5. Formulate the ratio between recommended serving size and actual serving size. For example, Recommended serving size of chips = 5  
Actual serving size of chips = 10  
Conclusion: Recommended serving size is  $\frac{1}{2}$  of actual serving chosen.
6. Repeat this activity in small groups using different kinds of food such as cereal, popcorn, peanuts, raisins, or others.
7. Share findings.
8. Have the students write a brief paragraph discussing the discrepancies between the manufacturer's serving size and the student's actual serving size.

Optional:

9. Students can plan and hold a debate: one team represents a food company, supporting their reasons for serving sizes as stated on product container; the other team represents consumers who feel that there is an unreasonable discrepancy between stated and actual serving size.

**EVALUATION:**

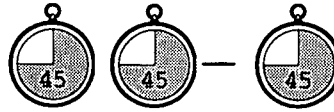
1. Completion of short paragraph.

**RESOURCES:**

1. "Pyramid Power: Snack Appeal, Learning from Advertisements." Write to: Ohio Department of Education, Nutrition Education and Training, 65 S. Front Street, Columbus, OH 43266.
2. Pennington J, Food Values of Portions Commonly Used, 15th ed., Harper Perennial, NY, 1989.



## LESSON TWO: "It All Adds Up"



**TIME:** two to three 45-minute classes

**Note to Teacher:** In clinical studies, nutritionists recommend recording three days (two weekdays and one weekend day) of kilocalorie intake to obtain an accurate picture of an individual's intake. To simplify this lesson, one day is suggested because of the students' difficulty in maintaining an accurate food log for a three-day period.

**OBJECTIVES:** The Student will:

1. Define calorie and kilocalorie;
2. Use a kilocalorie chart to determine daily intake;
3. Compile and complete a sample food log; and
4. Record one day's food intake by serving size.

### VOCABULARY:

calorie: the heat needed to raise one gram of water one degree Celsius

energy: the capacity to do work

kilocalorie (Kcal / food calorie): the heat needed to raise 1,000 grams (1 liter) of water one degree Celsius

ounce: a small unit of measure (16 oz. = 1 lb., 8 oz. = 1 cup)

serving size: an arbitrary helping of food or drink

### MATERIALS AND EQUIPMENT:

Lab Sheet N-2A (example)

Lab Sheet N-2B **\*This particular lab sheet must be saved for future lessons.**

Lab Sheet N-2C, common foods kilocalorie calorie chart

"Food Models" National Dairy Council, 1990; **strongly recommended**; (ISBN 1-5564-7042-6), (708) 803-2000; an option is to make your own

"Guide to Good Eating" National Dairy Council, 1989; (ISBN 1-5564-7001-0); also available from the Dairy and Nutrition Council-Mid East (614) 890-1800.

Teacher Information Sheet N-2D

calculators

### PREPARATION:

1. Duplicate Lab Sheets N-2A and N-2C, one per student, and N-2B, two per student.
2. Divide food models into approximately four groups and put into four envelopes. Make sure each envelope has a wide variety of foods.

### PROCEDURE:

1. Explain expenditure of a kilocalorie. One kilocalorie is spent if students:
  - tie shoes for 15 seconds
  - brush hair for 25 sec.
  - sew for 50 sec.
  - sing for 25 sec.
2. Divide class into approximately four groups.
3. Distribute and discuss Lab Sheet N-2A (example)



4. Distribute food intake envelopes with pictures to each group, and Lab Sheet N-2B and N-2C, one each per student.
5. Each group completes Sample Food Log, N-2B, from envelope of food choices.
6. Have students calculate kilocalories on Sample Food Log, N-2B, using N-2C.
7. Distribute an additional Lab Sheet N-2B, to be used for Steps 8 and 9.
8. Have students record total food and drink intake for one day.
9. Have students calculate total kilocalorie intake for one day on Lab Sheet N-2B, using Lab Sheet N-2C.
10. Discuss Lab Sheet N-2B using information from Teacher Information Sheet N-2D.

**EVALUATION:**

1. Accuracy of individual food logs, N-2B.

Optional:

2. Accuracy of group food logs, N-2B.

**RESOURCES:**

1. Wardlaw G and Insel P, Perspectives in Nutrition, Times Mirror/Mosby Pub., St. Louis, MO, 1990.
2. Wardlaw G and Insel P, Contemporary Nutrition, Mosby - Yearbook, Inc., St. Louis, 1994. ISBN 0-8016-7760-2.
3. dietician/nutritionist
4. Try Foods International, Inc., P.O. Drawer 2248, Apopka, FL 32704; 1-800-421-0809
5. Dairy Council of Wisconsin, 999 Oakmont Plaza Drive, Suite 510, Westmont, IL 60559; 1-800-325-9

Name: David Baird

# IT ALL ADDS UP

## Kilocalorie Intake

Time	Food	# of Servings	# of Calories
6:30 a.m.	Cereal - Lucky Charms	2	250
	milk - 2%	1	121
	orange juice	1	104
11:15 a.m.	peanut butter (smooth)	2	190
	bread	2	120
	grape jelly	2	110
	potato chips	25 chips	250
	chocolate milk	1	208
	Twinkie	1	143
3:00 p.m.	donut (glazed)	1	205
	apple	1	81
6:00 p.m.	tossed salad	1	25
	italian dressing	2	140
	meatloaf	2	426
	macaroni & cheese	1	230
	canned green beans	1	27
	catsup	2	30
	cake & icing	1	268
8:30 p.m.	popcorn	3	75
(include all meals and snacks)			Total Kilocalories
			3,003

82

Name: \_\_\_\_\_

# IT ALL ADDS UP

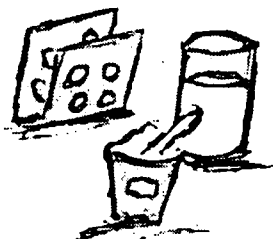
## Kilocalorie Intake

Time	Food	# of Servings	#of Calories
(include all meals and snacks)		Total Kilocalories	

NAME: \_\_\_\_\_

### Common Foods Kilocalorie Chart Milk, Cheese and Yogurt

<b>Food Name</b>	<b>Serving Size</b>	<b>KCalories</b>
American Cheese	1 oz	106
Butter	1 tsp	34
Butter (Margarine)	1 tsp	34
Cheese Brick	1 oz	105
Cheddar Cheese	1 oz	114
Cheese Mozzarella	1 oz	80
Cheese Mozzarella (Part Skim)	1 oz	72
Cheese Monterey	1 oz	106
Cheese Swiss	1 oz	107
Cheese Muenster	1 oz	104
Cheese Parmesan	1 tbsp	23
Cottage Cheese (creamed)	.5 cup	109
Cottage Cheese (2% lowfat)	.5 cup	102
Cottage Cheese (1% lowfat)	.5 cup	82
Cream Cheese	1 oz	99
Cream Cheese (neufchatel)	1 oz	74
Frozen Yogurt	.5 cup	72
Half-and-Half & Coffee Whitener	1 tbsp	20
Ice Cream Hardened (10% fat)	.5 cup	135
Ice Cream Hardened (16% fat)	.5 cup	175
Ice Milk	.5 cup	92
Milk- Chocolate (whole)	1 cup	208
Milk- Chocolate (2%)	1 cup	179
Milk (skim)	1 cup	86
Milk (nonfat dry)	1 cup	82
Milk (whole)	1 cup	150
Milk (1% lowfat)	1 cup	102
Milk (2% lowfat)	1 cup	121
Milk (buttermilk)	1 cup	99
Milkshake (chocolate)	10 fl oz	360
Milkshake (strawberry)	10 fl oz	319
Milkshake (vanilla)	10 fl oz	314
Pudding (cooked)	.5 cup	150
Pudding (instant)	.5 cup	155
Pudding (canned)	.5 cup	188
Soft Serve	.5 cup	189
Sour Cream	1 tbsp	26
Sour Half and Half	1 tbsp	20
Yogurt- Plain	1 cup	14
Yogurt- fruit flavored	1 cup	225



84

**Meat, Poultry, Fish, Dry Beans, Eggs and Nuts**

<b>Food Name</b>	<b>Serving Size</b>	<b>KCalories</b>
Bacon	3 slices	109
Bacon (Canadian bacon)	2 slices	86
Baked Beans (vegetarian)	.5 cup	118
Baked Beans (with pork)	.5 cup	123
Beans (pinto dried cooked)	.5 cup	117
Beans (refried canned)	.5 cup	134
Chicken- Fried (flour coated)	3 oz	186
Chicken- Fried (batter dipped)	3 oz	218
Chicken- Roasted (meat and skin)	3 oz	165
Chicken- Roasted (meat only)	3 oz	139
Egg (fried)	1 egg	83
Egg (scrambled)	1 egg	95
Egg-Hard Cooked (whole egg)	1 egg	79
Egg-Hard Cooked (white only)	1 egg	16
Fish (halibut)	3 oz	119
Fish (perch)	3 oz	103
Fish (flounder/ sole)	3 oz	99
Fish Sticks (frozen oven heated)	3 oz	228
Ground Beef (ground sirloin round)	3 oz	217
Ground Beef (ground beef)	3 oz	246
Ham (11% fat)	3 oz	156
Ham (5 % fat)	3 oz	111
Ham (chicken)	3 oz	110
Hot Dog (beef)	2 oz	184
Hot Dog (chicken)	2 oz	146
Peanuts (oil roast)	.25 cup	209
Peanuts (dry roast)	.25 cup	214
Peanut Butter (smooth)	2 tbsp	188
Peanut Butter (chunky)	2 tbsp	188
Pork (chop broiled)	3 oz	219
Pork (roast roasted)	3 oz	141
Pork Sausage (patty)	1 patty	100
Pork Sausage (link)	2 Links	96
Roast Beef (separable lean)	3 oz	164
Roast Beef (separable lean & fat)	3 oz	216
Roast Beef Sandwich	1 sandwich	346
Sausage (bratwurst)	2 oz	256
Sausage (italian)	3 oz	268
Sausage (polish)	3 oz	276
Shrimp (boiled)	3 oz	84
Shrimp (breaded and fried)	3 oz	206



Steak- Sirloin	3 oz	180
Steak- T-bone	3 oz	182
Steak- Rib Eye	3 oz	191
Sunflower Seeds (dry roasted)	.25 cup	186
Sunflower Seeds (oil roasted)	.25 cup	208
Tofu (with calcium sulfate)	.5 cup	94
Tofu (without calcium sulfate)	.5 cup	94
Tuna (canned in water)	3 oz	116
Tuna (canned in oil)	3 oz	158
Turkey (light meat and skin)	3 oz	138
Turkey (dark meat and skin)	3 oz	153



### Condiments

Food Name	Serving Size	KCalories
Barbecue	1 tbsp	12
Butter/Margarine	1 tsp	34
Catsup	1 tbsp	15
Chocolate Candy Bar (plain)	1 oz	145
Chocolate Candy Bar (w/almonds)	1 oz	150
French Dressing (regular)	1 tbsp	67
French Dressing (low calorie)	1 tbsp	22
Gelatin	.5 cup	70
Gravy	.25 cup	31
Honey	1 tsp	22
Jelly	1 tsp	17
Maple Syrup	1 tbsp	61
Mayonnaise	1 tbsp	99
Mustard	1 tbsp	12
Salad Dressing (Italian)	1 tbsp	69
Salad D. (Oil and Vinegar Homemade)	1 tbsp	72
Sugar	1 tsp	15

### Beverages

Food Name	Serving Size	KCalories
Coffee	1 cup	8
Ice Tea (sugar sweetened)	12 fl oz	131
Ice Tea (unsweetened)	12 fl oz	6
Soft Drink (regular)	12 fl oz	151
Soft Drink (low calorie)	12 fl oz	2
Tea	1 cup	8

### Vegetable Group

<b>Food Name</b>	<b>Serving Size</b>	<b>KCalories</b>	
Beans, Green (fresh cooked)	.5 cup	22	
Beans, Green (frozen cooked)	.5 cup	18	
Beans, Green (canned cooked)	.5 cup	13	
Navy Beans (dried cooked)	.5 cup	129	
Navy Beans (canned)	.5 cup	148	
Broccoli (fresh)	.5 cup	12	
Broccoli (fresh, cooked)	.5 cup	23	
Cabbage (fresh)	.5 cup	8	
Cabbage (fresh cooked)	.5 cup	16	
Carrots (fresh)	1 carrot	31	
Carrots (fresh cooked)	.5 cup	35	
Cauliflower (fresh)	.5 cup	12	
Cauliflower (fresh, cooked)	.5 cup	15	
Celery	1 stalk	6	
Corn (fresh)	.5 cup	67	
Corn (canned, cream style)	.5 cup	93	
Corn on Cob	1 ear	83	
Coleslaw	.5 cup	42	
Green Pepper	.5 pepper	9	
Lettuce (Iceberg)	1 leaf	3	
Lettuce (Romaine)	1 leaf	2	
Lettuce (loose leaf, shredded)	.5 cup	5	
Peas- Black-Eyed (dried cooked)	.5 cup	100	
Peas- Black-Eyed (canned)	.5 cup	92	
Peas-Green (fresh cooked)	.5 cup	67	
Peas-Green (frozen cooked)	.5 cup	63	
Peas-Green (canned, cooked)	.5 cup	59	
Peas-Snow (fresh, cooked)	.5 cup	34	
Peas-Snow (frozen,cooked)	.5 cup	42	
Pickle- Dill	1 pickle	5	
Pickle- Sweet Gherkin	1 pickle	20	
Potato Baked (flesh and skin)	1 large	202	
Potato (flesh only)	1 large	156	
Potato Chips	1 oz	148	
Potato (French-Fried)	10 strips	111	
Potato (French-Fried)	10 strips	158	
Spinach (fresh)	.5 cup	6	
Spinach (Fresh Cooked)	.5 cup	21	
Squash, Winter (baked fresh)	.5 cup	39	
Sweet Potato	.5 medium	59	
Sweet Potato	.5 medium	144	



Tomato Juice	.5 cup	21
Tomato Juice (low sodium)	.5 cup	21
Tossed Salad	.5 cup	11
Zucchini (fresh)	.5 cup	9
Zucchini (fresh, cooked)	.5 cup	14

### Fruit

Food Name	Serving Size	Kcalories
Apple	1 medium	81
Applesauce (unsweetened)	.5 cup	53
Applesauce (sweetened)	.5 cup	97
Avocado (sliced)	.5 medium	162
Avocado (pureed)	.5 cup	185
Banana	1 medium	105
Cantaloupe	.25 melon	47
Fruit Cocktail (in juice)	.5 cup	56
Fruit Cocktail (in light syrup)	.5 cup	72
Fruit Cocktail (in heavy syrup)	.5 cup	93
Grape	.5 cup	29
Grapefruit	.5 medium	38
Orange Juice (canned)	.5 cup	52
O.J. (frozen reconstituted)	.5 cup	56
Peach	1 medium	37
Peaches (in juice)	.5 cup	55
Peaches (in light syrup)	.5 cup	68
Peaches (in heavy syrup)	.5 cup	95
Pear	1 medium	98
Pear (in juice)	.5 cup	62
Pear (in light syrup)	.5 cup	72
Pear (in heavy syrup)	.5 cup	94
Pineapple (fresh)	.5 cup	39
Pineapple (canned in juice)	.5 cup	75
Pineapple (canned in heavy syrup)	.5 cup	100
Prunes (uncooked)	.25 cup	96
Prunes (cooked without sugar)	.25 cup	113
Prunes (cooked with sugar)	.25 cup	147
Raisin	.25 cup	109
Orange	1 medium	62
Strawberries	.5	23
Tomato (fresh)	1 tomato	24
Tomato (canned)	.5 cup	24
Watermelon	.5 cup	25





### Grain and Cereal

<b>Food Name</b>	<b>Serving Size</b>	<b>Kcalories</b>
Bran Flakes	1 oz	92
Bagel (plain)	.5 bagel	100
Bread- Pita	.5 pita	83
Bread- Pumpnickel	1 slice	80
Bread- Rye	1 slice	65
Bread- Wheat (whole wheat)	1 slice	70
Bread- Wheat (cracked wheat)	1 slice	65
Bread- White	1 slice	65
Brownie (with nuts)	1 brownie	95
Brownie (with nuts and frosting)	1 brownie	100
Biscuit (refrigerated dough)	1 biscuit	65
Biscuit (mix)	1 biscuit	95
Bun (hot dog)	.5 roll	58
Bun (hamburger)	.5 roll	58
Cake- Chocolate	1/16 cake	235
Cake- Angel Food Cake	1/12 cake	125
Chips (tortilla)	1 oz	139
Chips (corn)	1 oz	155
Chocolate Chip Cookies (commercial)	2 cookies	90
Chocolate Chip Cookies (homemade)	2 cookies	93
Choc. Chip Cookies (refrig. dough)	2 cookies	113
Corn Flakes	1 oz	110
Corn Flakes (sugar frosted flakes)	1 oz	108
Crackers- snack	4 crackers	60
Crackers (rye)	2 crackers	55
Crackers (whole wheat)	2 crackers	35
Croissant	.5 croissant	118
Doughnut (yeast, glazed)	1 doughnut	235
Doughnut (cake type, plain)	1 doughnut	210
Egg Noodles	.5 cup	106
English Muffin (Plain, toasted)	.5 muffin	70
Granola	1 oz	126
Granola Bar	1 oz	127
Graham Crackers	2 crackers	60
Grits (regular and quick serve)	.5 cup	73
Hashed Brown Potato	.5 cup	163
Macaroni (plain)	.5 cup	99
Macaroni (Protein fortified)	.5 cup	95
Macaroni (vegetable)	.5 cup	86
Muffin (bran)	1 small	140
Muffin (blueberry)	1 small	140



Oatmeal (instant, cooked)	.5 cup	73
Oatmeal (cream of wheat, instant)	.5 cup	77
Pancake (plain)	1 pancake	60
Pancake (buckwheat)	1 pancake	55
Popcorn (unbuttered)	1 cup	55
Popcorn (buttered)	1 cup	89
Potatoes (fresh potatoes)	.5 cup	111
Potatoes- Mashed (dehydrated flakes)	.5 cup	118
Pretzels	1 oz	112
Raisin Bran	1 oz	87
Rice (white long grain)	.5 cup	131
Rice (brown long grain)	.5 cup	109
Rice (wild)	.5 cup	83
Roll- Dinner	1 roll	85
Roll- Hard	.5 roll	78
Saltine Crackers	4 crackers	50
Sweet Roll (fruit)	1 roll	335
Sweet Roll (cinnamon)	1 roll	349
Tortilla (corn)	6" tortilla	65
Tortilla (flour)	8" tortilla	105
Waffle (mix)	7" waffle	205
Waffle (frozen)	4" waffle	98



<b>Food Name</b>	<b>Combinations Serving Size</b>	<b>KCalories</b>
Beef and Vegetable Stew (Homemade)	1 cup	220
Beef and Vegetable Stew (canned)	1 cup	245
Burrito (bean)	1 burrito	224
Burrito (bean and meat)	1 burrito	254
Burrito (beef)	1 burrito	262
Cheeseburger (regular)	1 sandwich	359
Cheeseburger (large)	1 sandwich	564
Chef Salad	1.5 cups	267
Chicken Noodle Soup (canned)	1 cup	75
Chicken Noodle Soup (Dehydrated)	1 cup	53
Chicken Stir-Fry	1.5 cups	490
Chicken Pot Pie (homemade)	1/4 of 9" pie	409
Chicken Pot Pie (frozen baked)	1 pot pie	430
Chop Suey/Chow Mein (beef & pork)	1 cup	300
Chop Suey/Chow Mein (chicken)	1 cup	255
Chili	1 cup	254
Clam Chowder (w/ whole milk)	1 cup	163
Clam Chowder (w/ water)	1 cup	95
Cream of Tomato Soup (w/whole milk)	1 cup	160
Cream of Tomato Soup (w/water)	1 cup	86
Enchilada (cheese)	1 enchilada	320
Enchilada (cheese and beef)	1 enchilada	324
Fish Sandwich (without cheese)	1 sandwich	431
Fish Sandwich (with cheese)	1 sandwich	524
Lasagna (without meat)	1 piece	316
Lasagna (w/ meat)	1 piece	398
Macaroni and Cheese (homemade)	1 cup	430
Macaroni and Cheese (frozen, cooked)	1 cup	254
Peanut Butter and Jelly Sandwich	1 sandwich	347
Pie (chocolate cream)	1/8 of 9" pie	233
Pie (apple)	1/8 of 9" pie	303
Pie (pecan)	1/8 of 9" pie	431
Pizza (cheese)	1/4 of 12"	218
Pizza (cheese and pepperoni)	1/4 of 12"	270
Pizza (cheese, meat, and vegetables)	1/4 of 12"	303
Quiche	1/8 of 8" pie	342
Quiche (w/bacon)	1/8 of 8" pie	288
Submarine Sandwich	3"-4"	228
Spaghetti with Meat Balls (homemade)	1 cup	330
Spaghetti with Meat Balls (canned)	1 cup	260
Taco	small	370
Tuna Salad	.5 cup	192
Tuna Salad (w/chicken)	.5 cup	266
Turkey Sandwich	1 sandwich	298



NAME: \_\_\_\_\_

Lab Sheet N-2D Page 1

# TEACHER INFORMATION SHEET

## 1 to 10 YEAR OLD CHILD

Studies of children's diets have shown that there is often a need for more vegetables (especially dark green and yellow ones), whole grain or enriched cereals and breads, and milk. Some very young children, however, drink too much milk (more than three cups a day), which means that other important foods are likely to be neglected.

Children need three good meals a day plus snacks, especially if they are very active. Their snack foods should be small servings of the same nutritious foods needed at mealtime, such as fruits, juices, milk, crackers with peanut butter or cheese, small sandwiches, raw vegetables, nuts, or cereals. If a child's appetite is poor or s/he seldom eats much at any one time, it is doubly important that his/her snacks be foods that are rich in protein, vitamins, and minerals.

Poor appetites are fairly common among preschool children. Growth rates slow down after infancy, and some children may go for weeks or months without gaining weight. The "refusal to eat" period is a difficult time for parents, but there is usually no cause for concern unless the problem persists. Parents should encourage children to eat the foods they need but should not make mealtime an unpleasant event by nagging, bribing or forcing foods. By the time children are 7 to 10 years old, they usually have very good appetites. In fact, they are growing so fast and using so much energy that they need more calories (about 2,400) each day than most women need.

## ADOLESCENT

The adolescent growth spurt begins in girls as early as 10 or 11 years of age and in boys between 13 to 15 years. Most teenage boys have big appetites, and they may need more than 3,000 calories a day when they are growing and active. Because they usually eat so much, boys are more likely than girls to get all the nutrients they need. After age 14 or 15, girls need fewer calories (about 2,100) than they needed during the growth spurt (about 2,400).

Some teenagers are overweight because of a combination of poor diet and lack of exercise. Both good nutrition and exercise are necessary for true physical fitness, which is the foundation of health, good looks, and vitality. It is unwise for adolescents to try to lose weight quickly on a diet that is extremely low in calories and inadequate in nutrients. Weight loss should be achieved slowly by an adequate diet and regular, vigorous exercise.

Teenagers generally determine their own food preferences and eating habits. A poor breakfast or no breakfast (especially among girls) and careless food choices are fairly common. At least three good meals a day are recommended for all teens, and those who are athletic will need one or two hearty snacks in addition. Once girls have reached adolescence, their iron requirements are greater than those of boys.

Most teenagers should be able to eat some foods just for pleasure, if they are getting at least the minimum recommended servings of the foods needed each day for an adequate diet.

### LESSON THREE: "Peer Amid That Food"

**TIME:** two 45-minute classes



Note to Teacher: Many foods are consumed in combination (sandwiches, pasta dishes, chef's salads, etc.). It will be necessary to discuss with students that they need to mentally separate the food groups and estimate quantities of each. For example, a serving of pizza (1/4 of 12") with cheese and pepperoni may be considered as: one serving of dairy (cheese), two servings of grain (crust), 1/4 serving of meat (pepperoni), 1/2 serving of fat (from pepperoni and cheese), and one serving of vegetable (tomato sauce).

**OBJECTIVES:** The Student will:

1. Compare his/her own food intake from individual Lab Sheet N-2B with recommended food pyramid; and
2. Categorize food labels from Lesson One to determine if a proper food pyramid can be constructed.

### VOCABULARY:

food pyramid: a graphic representation of a variety of foods used to get the nutrients that you need each day

nutrients: chemical substances in food that nourish the body

### MATERIALS AND EQUIPMENT:

Food Guide N-3A

Lab Sheet N-3B

Individual Lab Sheets N-2B (from previous lesson) **Please save for Lessons 5 and 6!**

poster board (one per class or group)

food labels and/or food models (from Lessons One and Two)

### PREPARATION:

1. Duplicate N-3A and N-3B, one each per student.
2. Be sure students have their individual Lab Sheet N-2B.
3. Obtain food labels from Lesson One.

### PROCEDURE:

1. Distribute and discuss Lab Sheet N-3A. Discussion examples: food groups, allotted servings, and the food group placement on the pyramid.
2. Distribute Lab Sheet N-3B.
3. Complete and discuss Lab Sheet N-3B. (Food Log N-2B is needed to complete this activity.)
4. Discuss dietetic strengths and weaknesses found in students' food pyramids.
5. Using bulletin board or poster board and food labels/models, construct a food pyramid (class or groups).

**EVALUATION:**

1. Completion of Lab Sheet N-3B.
2. Completion of food pyramid posters or bulletin board.

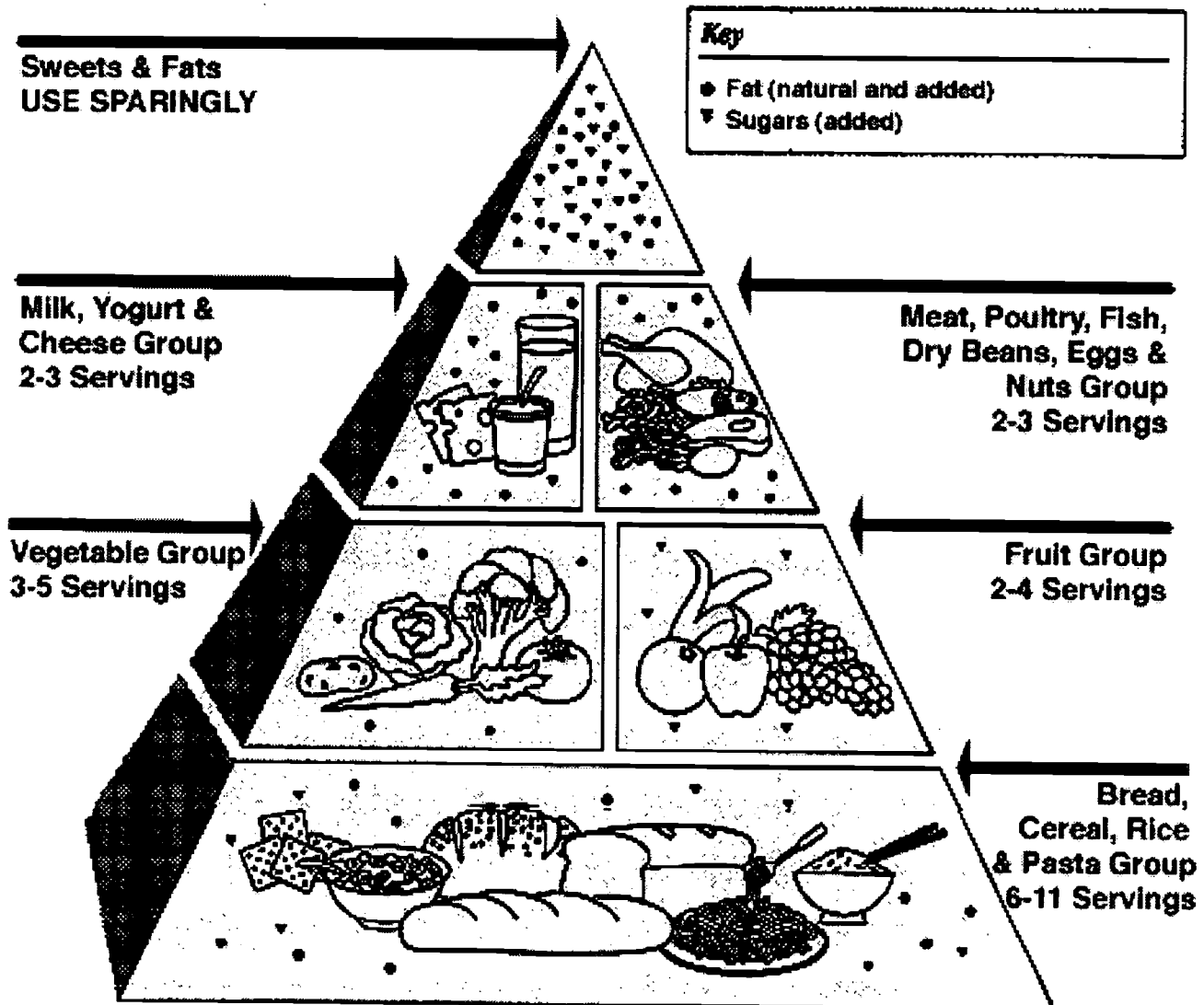
**RESOURCES:**

1. Human Nutrition Information Service, U.S. Department of Agriculture, 6505 Belcrest Road, Hyattsville, MD 20782. Ask for a variety of information.
2. local cooperative extension agent in your county
3. "Food Models", (ISBN 1-5564-7042-6) National Dairy Council, 1990.

# EXAMPLE FOOD PYRAMID

## The Food Guide Pyramid

A guide to Daily Food Choices





Name: \_\_\_\_\_

## “PEER AMID THAT FOOD”

1. Shade a block for each serving in the correct food group from your “It All Adds Up” Lab Sheet N-2B.
2. How does your food pyramid compare to the example food pyramid (Lab Sheet N-3A) ?

Fats, oils &amp; sweets


Milk, yogurt &amp; cheese


Meat, poultry, fish,  
dry beans, eggs & nuts group

Vegetable group


Fruit group


Bread, cereal, rice and pasta group

\* Blocks should be completed within the pyramid first, then extend out if necessary.

## LESSON FOUR: "Movers and Shakers"

**TIME:** two 45-minute classes



**Note to Teacher:** In clinical studies, nutritionists recommend recording three days (two weekdays and one weekend day) of activities in order to get an accurate picture of an individual's activities. To simplify this lesson, one day is suggested because of the students' difficulty in maintaining accurate activity logs for a three-day period.

**OBJECTIVE:** The Student will:

1. Record one day of activities in order to compute kilocalorie expenditure.

### **VOCABULARY:**

activity: a description of what a person is doing, whether or not he/she is moving

### **MATERIALS AND EQUIPMENT:**

Lab Sheets N-4A through N-4D  
calculators

### **PREPARATION:**

1. Duplicate Lab Sheets N-4A, N-4B, N-4C, and N-4D, one each per student.

### **PROCEDURE:**

DAY 1:

1. Distribute and discuss Lab Sheets N-4A and N-4B.
2. Distribute and explain Lab Sheet N-4C; perform sample calculations.
3. Assign Lab Sheet N-4B.

DAY 2:

4. Distribute and complete Lab Sheet N-4D.

### **EVALUATION:**

1. Completion of Lab Sheets N-4B and N-4D.

### **RESOURCES:**

1. Wardlaw G and Insel P, Perspectives in Nutrition, Times Mirror/Mosby College Pub., St. Louis, 1990.
2. Wardlaw G and Insel P, Contemporary Nutrition, Mosby - Yearbook, Inc., St. Louis, 1994. ISBN 0-8016-7760-2.

# EXAMPLE ACTIVITY LOG

Hours	1st 15 min	2nd 15 min	3rd 15 min	4th 15 min
8-9 am	walk to school	go to locker; talk	class starts	→ SIT
9-10 am	SIT			→
10-11 am	recess (run)	SIT		→
11-12 noon				→
12-1 pm	lunch	→	volley ball	→
1-2 pm	class - SIT			→
2-3 pm	stand & SIT			→
3-4 pm	walk home	→	eat snack	do chores →
4-5 pm	→ chores	PLAY		→
5-6 pm	→	homework		→
6-7 pm	wash/talk with parents		DINNER	→
7-8 pm	walk the dog	→	talk on phone	→
8-9 pm	watch TV	→	play video games	→
9-10 pm	read		→	brush teeth, etc.
10-11 pm	SLEEP			→
11-12 mid				→
12-1 am				→
1-2 am				→
2-3 am				→
3-4 am				→
4-5 am				→
5-6 am				→
6-7 am		→	eat breakfast	get dressed
7-8 am	make lunch	play with dog	walk to school	→

Column totals \_\_\_\_\_ + \_\_\_\_\_ + \_\_\_\_\_ + \_\_\_\_\_  
day total = \_\_\_\_\_

BEST COPY AVAILABLE

Name: \_\_\_\_\_

Lab Sheet N-4B

# ACTIVITY LOG

Hours	1st 15 min	2nd 15 min	3rd 15 min	4th 15 min
8 - 9 am				
9 - 10 am				
10 - 11 am				
11 - noon				
12 - 1 pm				
1 - 2 pm				
2 - 3 pm				
3 - 4 pm				
4 - 5 pm				
5 - 6 pm				
6 - 7 pm				
7 - 8 pm				
8 - 9 pm				
9 - 10 pm				
10 - 11 pm				
11 - 12 MID				
12 - 1 am				
1 - 2 am				
2 - 3 am				
3 - 4 am				
4 - 5 am				
5 - 6 am				
6 - 7 am				
7 - 8 am				

Column totals      +      +      +      =

day total

NAME: \_\_\_\_\_

## K-CALORIE EXPENDITURE CHART

1. Convert individual weight from the below pounds and kilogram chart (approximate calculation is 2.2 kg per pound).

pounds	kilograms	pounds	kgs	pounds	kgs
61	28	117	53	170	77
68	31	123	56	176	80
75	34	130	59	183	83
82	37	137	62	190	86
89	40	143	65	196	89
96	44	150	68	203	92
103	47	157	71	209	95
110	50	163	74	216	98



2. Use the formula below to calculate the number of calories you expend per minute on each activity.

specific activity x individual weight = K-calories expended x minutes = \_\_\_\_\_  
numerical value in kilograms per minute

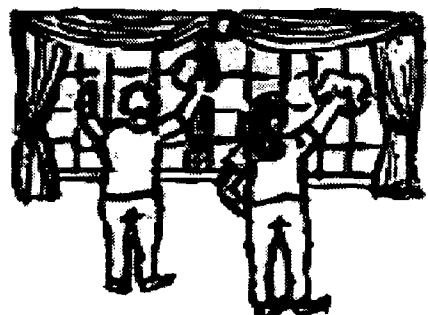
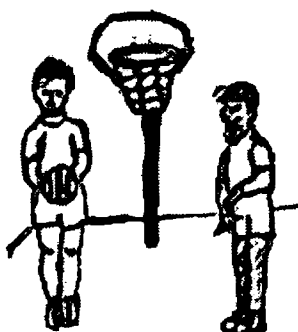
EXAMPLE:

(basketball) x (96 pounds) = 6 K-calories per x 15 = \_\_\_\_\_  
0.135 44 kg minute expended

NAME: \_\_\_\_\_

# KILOCALORIE EXPENDITURE CHART

Activity	Numerical Value	Activity	Numerical Value
Aerobics heavy	0.132	Music playing:	
Aerobics light	0.050	Accordion	0.032
Basketball	0.135	Cello	0.041
Billiards	0.042	Drums	0.066
Bookbinding	0.038	Flute	0.035
Bowling	0.065	Horn	0.029
Calisthenics	0.133	Organ	0.053
Canoeing	0.044	Piano	0.040
Card playing	0.025	Trumpet	0.031
Carpet sweeping	0.047	Violin	0.045
Cleaning	0.060	Woodwind	0.032
Climbing hills	0.121	Printing	0.035
Cooking	0.047	Roller Skating	0.085
Cycling	0.100	Running	0.163
Dancing	0.168	Sitting quietly	0.021
Drawing	0.036	Skiing	0.111
Dress/Shower	0.026	Sleeping	0.020
Eating	0.023	Standing quietly	0.026
Field hockey	0.134	Swimming:	
Fishing	0.062	Backstroke	0.169
Food shopping	0.060	Breast stroke	0.162
Football	0.132	Crawl	0.142
Gardening	0.060	Side stroke	0.122
Golf	0.085	Treading	0.062
Gymnastics	0.066	Table tennis	0.068
Horse-grooming	0.128	Tennis	0.109
Ice Skating	0.096	Typing	0.030
Ironing	0.048	Volleyball	0.050
Judo	0.195	Walking	0.080
Sewing	0.022	Weight Lifting	0.150
Lying at ease	0.022	Window cleaning	0.059
Marching (rapid)	0.142	Writing	0.029
Mopping floor	0.060		
Mowing lawn	0.122		



Name: \_\_\_\_\_

Lab Sheet N-4D

# Movers & Shakers

Personal Kilocalorie Expenditure Log

- Referring to "Daily Activity Log" N-4B fill in the kilocalories expended for each 15 minute period. (Using Kilocalorie Expenditure Chart N-4C.)
- Complete column totals and day total.

Hours	1st 15 min	2nd 15 min	3rd 15 min	4th 15 min
8 - 9 am				
9 - 10 am				
10 - 11 am				
11 - 12 noon				
12 - 1 pm				
1 - 2 pm				
2 - 3 pm				
3 - 4 pm				
4 - 5 pm				
5 - 6 pm				
6 - 7 pm				
7 - 8 pm				
8 - 9 pm				
9 - 10 pm				
10 - 11 pm				
11 - 12 mid				
12 - 1 am				
1 - 2 am				
2 - 3 am				
3 - 4 am				
4 - 5 am				
5 - 6 am				
6 - 7 am				
7 - 8 am				

Column totals \_\_\_\_\_ + \_\_\_\_\_ + <sup>91</sup>103 + \_\_\_\_\_ = \_\_\_\_\_ day total

## LESSON FIVE: "The Balancing Act"

**TIME:** one 45-minute class



**OBJECTIVES:** The Student will:

1. Compare and contrast daily kilocalorie intake versus energy expenditure;
2. Complete a self-assessment based on the results of the kilocalorie intake and expenditure charts; and
3. List and justify one suggestion for positive change toward a healthier lifestyle.

### VOCABULARY:

Kilocalorie(Kcal/ food calorie): the heat needed to raise 1,000 grams(1 liter) of water one degree Celsius

### MATERIALS AND EQUIPMENT:

Lab Sheets N-2B and N-2D (from Lesson Two)  
 Lab Sheets N-4B and N-4D (from Lesson Four)  
 Lab Sheet N-5A (Optional)  
 calculators, one per student

### PREPARATION:

1. Be sure students have necessary Lab Sheets for this activity.

### PROCEDURE:

1. Students will compare kilocalorie intake from Lab Sheet N-2B with kilocalorie expenditure from Lab Sheet N-4D.
2. Discuss Information Sheet N-2D.
3. Discuss healthy ways to achieve balance between kilocalorie intake vs expenditure.
4. Have students develop a plan including at least one change toward a more healthy lifestyle.

Optional:

5. Have students calculate daily energy needs using Lab Sheet N-5A.
6. Discuss the following questions-
  - a. What happens when people try to lose weight by decreasing calories but not adding exercise?
  - b. What is the danger of focusing only on the food intake when thinking about weight loss?
  - c. What are the advantages of including exercise in your plan for good health?

### EVALUATION:

1. Completion and implementation of students' plans toward a more healthy lifestyle.

Optional:

2. Accuracy of individual calculations on Lab Sheet N-5A.
3. Answers to discussion questions.



**RESOURCES:**

1. READ THE LABEL, Focus on Food Labeling, An FDA Consumer Special Report, May 1993.
2. Kowtaluk, H and Kopan, A. Food for Today. Macmillan/McGraw-Hill, Peoria, Illinois, 1994. ISBN 0-0267-6110-6.
3. Learning to Like Me. Dairy & Nutrition Council Mid East, 1993
4. Wardlaw G and Insel P, Perspectives in Nutrition. Times Mirror/Mosby College Pub., St. Louis, 1990.
5. Wardlaw G and Insel P, Contemporary Nutrition, Mosby - Yearbook, Inc., St. Louis, 1994. ISBN 0-8016-7760-2.

## NOTE TO THE TEACHER:

People who are overweight tend to be involved in a limited amount of physical activity and some studies have shown that they do not eat more than those who do not have a weight problem.

One pound of body fat represents about 3,500 calories. To lose one pound, about 3,500 calories must be adjusted from the current energy balance so you burn more calories than you consume. Eating 500 calories less each day for 7 days would be one approach. Burning 500 calories each day through exercise and other physical activities is a second approach. The most realistic approach would be to decrease caloric intake by 250 calories a day and increase activity to burn 250 calories daily. This approach is healthier, more realistic and less stressful to the body. Few people can make dramatic changes in their exercise or eating behaviors for a long period of time.

To gain weight, you must consume more calories than you burn. Eating 500 calories more each day for 7 days is one example. To avoid gaining all fat, you should perform aerobic exercise and become involved in a weight training program to increase muscle mass.

This formula is based on a theory, not a rule! Variables such as heredity, general health and environmental factors can complicate the issue. Any change in your eating plan should follow acceptable nutritional guidelines.

Another point to remember is that the duration and intensity of exercise affects caloric expenditure. The longer the duration of the activity, the more calories burned. Twenty minutes of aerobic exercise is the minimum necessary for developing and maintaining cardiovascular fitness. If weight loss is a goal, a longer period of time would be needed and if weight management or weight gain is the goal, 20 minutes would be sufficient. Intensity refers to how hard you exercise. Walking briskly for 10 minutes would burn more calories than walking slowly for 10 minutes.

Source: Learning to Like Me.  
Dairy & Nutrition Council

Name: \_\_\_\_\_

Lab Sheet N-5A

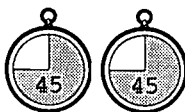
## ARE YOU IN BALANCE?

1. Calculate your weight in kilograms.  
(pounds divided by 2.2 = weight in kilograms) \_\_\_\_\_
2. Determine your basal energy need.  
(weight in kilograms x 22 [women] or 24 [men] = basal calories needed.) \_\_\_\_\_
3. Estimate the percent of basal calories required for your usual activity level. \_\_\_\_\_  

very sedentary	20%
sedentary	30%
moderately active	40%
very active	50%
4. Add the calories needed for basal metabolism and activities, then add 10% for digestion of food to find total daily energy needs. \_\_\_\_\_
5. Compare your answers with the following:  
 The U.S. Department of Agriculture Nutrition guidelines:  
 \*1800 calories for many sedentary (inactive) women and some older adults.  
 \*2200 calories for most children, teenage girls, active women and many sedentary men. Women who are pregnant or breastfeeding may need more.  
 \*2800 calories is about right for teenage boys, many active men and some very active women.
6. Using your Lab Sheet and other resources decide if any food eliminated from a teen's diet could reduce the number of calories per day by 250. Also calculate the addition of one new activity per day that would burn 250 calories to provide the loss of 500 calories per day to result in a 3500 calorie or one pound loss per week.

## LESSON SIX: "Thin At Any Cost?"

**TIME:** two 45-minute classes



**OBJECTIVES:** The Student will:

1. Develop a timeline illustrating the changes in the perception of the "ideal" body image over the years;
2. Summarize societal pressures to be the "ideal" body shape; and
3. Identify the dangers of restrictive dieting and meal skipping.

### VOCABULARY:

anorexia nervosa: an eating disorder involving a psychological loss of appetite and self-starvation

bulimia: an eating disorder in which large quantities of food are eaten at one time (bingeing) and soon purged from the body by means of vomiting, use of laxatives, or other means

diuretic: a substance which, when ingested, increases the output of urine

eating disorder: a pronounced disturbance in the way someone eats

lanugo: downy hair grown on the body to replace the insulation supplied by body fat

### MATERIALS AND EQUIPMENT:

variety of media portraying body images over time (possible sources: back issues of fashion magazines such as Life, Vogue, Ladies' Home Journal, etc., art history books, old photographs, and history books)

Pretest N-6A and Answer Key N-6B

"Love Food, Hate Food" (see below)

construction paper for the timeline

Optional:

personal survey N-6C

white drawing paper for self-portrait

video on eating disorders

### PREPARATION:

1. Have students bring in a variety of old books, magazines, etc. portraying "ideal" body images over time.
2. Duplicate Lab Sheet N-6A, one per student.

Optional:

3. Obtain and preview video on eating disorders.
4. Obtain resource speakers on eating disorders.
5. Duplicate Lab Sheet N-6C, one per student.

### PROCEDURE:

1. Divide students into small groups.
2. Students will construct an "ideal" body image timeline using collected media.
3. Discuss effects of advertisements on perceptions of body image.

4. Distribute, complete, and discuss Lab Sheet N-6A.
5. Discuss magazine article, "Love Food, Hate Food."

Optional:

6. Complete self-portrait and/or Lab Sheet N-6C. Self-portrait could be drawn on white paper or made as collage from pictures, advertisements, etc.
7. Have resource person speak to students about eating disorders.
8. Show and discuss video on eating disorders.

#### **EVALUATION:**

1. Completion of body image timeline.
2. Completion of Lab Sheet N-6A.

Optional:

3. Completion of Lab Sheet N-6C and/or self-portrait.

#### **RESOURCES:**

1. Wardlaw G and Insel P, Perspectives in Nutrition, Times Mirror/Mosby College Pub., St. Louis, MO, 1990, pp. 283-302.
2. Wardlaw G and Insel P, Contemporary Nutrition, Mosby - Yearbook, Inc., St. Louis, 1994. ISBN 0-8016-7760-2.
3. Barbera-Hogan M, "Love Food, Hate Food," Under 25, Vol.3, No.3, Winter, 1992, pp. 14-17.
4. National Anorexic Aid Society, 1925 Dublin Granville Road, Columbus, OH 43229. (614)846-2833
5. Cooper K, Kid Fitness, Bantam Books, NY, 1991, pp. 272-80.
6. Counselor from local eating disorders clinic

NAME: \_\_\_\_\_

Lab Sheet N-6A

## EATING DISORDERS PRE-TEST

# THIN AT ANY COST?

Circle the correct answer below:

1.    T   F        Human societies deal irrationally with food.
2.    T   F        Eating disorders are widespread in Western society.
3.    T   F        People with anorexia nervosa have an intense fear of losing weight.
4.    T   F        Bulimic people often engage in self-induced vomiting to control their weight.
5.    T   F        People with anorexia nervosa are often overachievers.
6.    T   F        People with anorexia nervosa have a distorted view of their own bodies.
7.    T   F        People with bulimia are aware that their eating patterns are abnormal.
8.    T   F        People with bulimia are easy to identify because of their openness about their problem.
9.    T   F        North American society favors the lean and angular look.
10.   T   F        The real problem underlying eating disorders is often how people feel about themselves.
11.   T   F        People with eating disorders are often perfectionists.
12.   T   F        Eating disorders are easier to treat at early stages.
13.   T   F        Bingeing is characteristic of bulimia.
14.   T   F        Treatment of bulimia emphasizes the immediate return to a strict diet.
15.   T   F        Baryophobia is a new eating disorder found in children.

NAME: \_\_\_\_\_

Lab Sheet N-6B

## EATING DISORDERS PRE-TEST KEY

# THIN AT ANY COST?

Answers to nutrition awareness inventory:

1. **True.** Often cultures use food in religious celebrations or as a reward. Some cultures see foods differently; in the United States waffles are a breakfast food, in England they are dessert.
2. **True.** About 5% of young women suffer from an eating disorder.
3. **False.** They have an intense fear of gaining weight.
4. **True.** This is referred to as purging.
5. **True.** People with anorexia nervosa tend to be extremely competitive.
6. **True.** People with anorexia nervosa see themselves as fat, even when they are thin.
7. **True.** But they don't like to admit it.
8. **False.** Bulimia is extremely secretive.
9. **True.** This attitude is reflected in advertisements.
10. **True.** Most people with eating disorders see themselves as inadequate.
11. **True.** People with eating disorders are often obsessively neat and highly aware of imperfections.
12. **True.** The damaging effects of late stages of these conditions increase the risk of permanent injury.
13. **True.** Bingeing and purging characterize bulimia.
14. **False.** Treatment should emphasize choice as opposed to restriction.
15. **True.** This should be suspected in children who exhibit poor growth rates.

NAME: \_\_\_\_\_

# PERSONAL SURVEY

1. What is beauty in a:  
girl -  
  
boy -
2. Who would you like to look like?  
Why?
3. Are you beautiful/handsome?
4. What parts do you **like** about yourself?

5. What parts do you **dislike** about yourself?

How could you change these?

6. Interview at least three friends or family members. Ask them who they consider to be beautiful or handsome and why?



## LESSON SEVEN: "Building Big Bones"

Note to Teacher: The role of calcium in the prevention of osteoporosis is known to be quite significant. Please read Lab Sheet N-7B in preparation for this lesson.

**TIME:** one 45-minute class



**OBJECTIVES:** The Student will:

1. Describe the importance of adequate calcium intake in the prevention of osteoporosis; and
2. Identify foods which are good dietary sources of calcium.

### VOCABULARY:

calcium: a soft, white mineral substance which aids in building bones

osteoporosis: a medical condition resulting in porous bones that are easily fractured

U.S. RDA's (Recommended Dietary Allowances): the amount of a vitamin, mineral, or nutrient that a person should get in their daily diet, according to the U.S. Food and Drug Administration

### MATERIALS AND EQUIPMENT:

Lab Sheets N-7A and N-7B

Lab Sheet N-2B (kcalorie intake log from Lesson Two)

Optional:

National Dairy Council's "Food Models"

labels from food packaging

### PREPARATION:

1. Read Lab Sheet N-7B--Teacher information about osteoporosis and calcium intake.
2. Duplicate Lab Sheet N-7A, one per student, or "Food Models" (see Resources), or have students bring in nutritional information (packaging) from foods that contain calcium.
3. Locate Lab Sheet N-2B for each student or prepare sample daily menu, as in example N-2A.

### PROCEDURE:

1. Explain the importance of calcium in the prevention of osteoporosis.
2. Discuss RDA's--recommended dietary allowances--of various nutrients and how RDA's are listed on food labels and cartons (RDA's are listed by percentage). The current RDA of calcium is 1000 mg., but the June 1994 Consensus Conference on Optimal Calcium Intake recommends that 1500 mg per day should be the new RDA. Keep in mind that RDA's are general guidelines for an average healthy person.
3. Distribute information about calcium-rich foods. Students can use the National Dairy Council's "Food Models," if they are available, and determine on their own which foods are high in calcium. Lab Sheet N-7A also contains this information, or labels from food packaging could be used for nutritional information.
4. Divide class into small groups.
5. Using Lab Sheet N-2B, the kilocalorie intake log, have students determine which foods they ate that day are high in calcium. Have students answer the question, "Did I get my RDA of calcium that day?" Students will again use what they have learned about serving sizes

of foods.

6. Within their groups, students should compare calcium intake and calculate the average (mean) of calcium consumption for their group. Afterward, the groups can calculate an average for the entire class.
7. Discuss the average calcium intake for North Americans (see Teacher Information Sheet N-7B) and how the class compares to those averages. Students could graph their individual, group, or class information on calcium consumption. Like the information on Lab Sheet N-7B, students could organize this information by gender.
8. Draw conclusions about calcium needs, intake, and osteoporosis prevention.

Optional

9. Create a day's menus that are high in calcium-rich foods. How are the caloric total and the recommended food pyramid affected? Do any changes need to be made to the menus high in calcium?

### EVALUATION:

1. Accuracy of calcium intake calculations.
2. Accuracy of average of groups' calcium intakes.

### RESOURCES:

1. National Osteoporosis Foundation, Boning Up on Osteoporosis, and other consumer literature. Call 1-800-223-9994.
2. Nutritionists.
3. National Dairy Council, "Food Models," 1990 (ISBN 1-5564-7042-6). Write to the National Dairy Council, Rosemont, IL 60018-4233 for other consumer literature.
4. Wardlaw G and Insel P, Perspectives in Nutrition, Times Mirror/Mosby College Pub., St. Louis, 1990.
5. Wardlaw G and Insel P, Contemporary Nutrition, Mosby - Yearbook, Inc., St. Louis, 1994. ISBN 0-8016-7760-2.

NAME: \_\_\_\_\_

**Common Foods Calcium Chart**  
**Milk, Cheese, and Yogurt**

Food Name	Serving Size	%U.S. RDA Calcium
American Cheese	1 oz	106
Butter	1 tsp	34
Butter (Margarine)	1 tsp	34
Cheese Brick	1 oz	105
Cheese Cheddar	1 oz	114
Cheese Monterey	1 oz	106
Cheese Mozzarella	1 oz	80
Cheese Mozzarella (Part Skim)	1 oz	72
Cheese Muenster	1 oz	104
Cheese Parmesan	1 tbsp	23
Cheese Swiss	1 oz	107
Cottage Cheese (creamed)	.5 cup	109
Cottage Cheese (2% lowfat)	.5 cup	102
Cottage Cheese (1% lowfat)	.5 cup	82
Cream Cheese	1 oz	99
Cream Cheese (neufchatel)	1 oz	74
Frozen Yogurt	.5 cup	72
Half-and-Half & Coffee Whitener	1 tbsp	20
Ice Cream Hardened (10% fat)	.5 cup	135
Ice Cream Hardened (16% fat)	.5 cup	175
Ice Milk	.5 cup	92
Ice Milk	.5 cup	112
Milk- Chocolate (whole)	1 cup	208
Milk- Chocolate (2%)	1 cup	179
Milk (skim)	1 cup	86
Milk (nonfat dry)	1 cup	82
Milk (whole)	1 cup	150
Milk (1% lowfat)	1 cup	102
Milk (2% lowfat)	1 cup	121
Milk (buttermilk)	1 cup	99
Milkshake (chocolate)	10 fl oz	360
Milkshake (strawberry)	10 fl oz	319
Milkshake (vanilla)	10 fl oz	314
Pudding (cooked)	.5 cup	150
Pudding (instant)	.5 cup	155
Pudding (canned)	.5 cup	188
Soft Serve	.5 cup	189
Sour Cream	1 tbsp	26
Sour Half and Half	1 tbsp	20
Yogurt- Plain	1 cup	144
Yogurt- Fruit flavored	1 cup	225

### Meat, Poultry, Fish, Dry Beans, Eggs, and Nuts

Food Name	Serving Size	%U.S. RDA Calcium
Baked Beans (vegetarian)	.5 cup	6
Baked Beans (with pork)	.5 cup	7
Fish (halibut)	3 oz	5
Fish (perch)	3 oz	12
Fish (salmon, canned w/bones)	3 oz	20
Tofu (with calcium sulfate)	.5 cup	43
Tofu (without calcium sulfate)	.5 cup	13

### Vegetable Group

Food Name	Serving Size	% U.S. RDA Calcium
Broccoli (fresh, cooked)	.5 cup	9
Spinach (fresh, cooked)	.5 cup	12

### Grain and Cereal

Food Name	Serving Size	% U.S. RDA Calcium
Waffle (mix)	7" waffle	18
Waffle (frozen)	4" waffle	3

### Combinations

Food Name	Serving Size	% U.S. RDA Calcium
Cheeseburger (regular)	1 sandwich	18
Cheeseburger (large)	1 sandwich	21
Chef's Salad	1.5 cups	24
Enchilada (cheese)	1 enchilada	32
Enchilada (meat and cheese)	1 enchilada	23
Lasagna (without meat)	1 piece	46
Lasagna (with meat)	1 piece	46
Macaroni & Cheese (homemade)	1 cup	36
Macaroni & Cheese (frozen or cooked)	1 cup	18
Pizza (cheese)	1/4 of 12"	18
Pizza (cheese and pepperoni)	1/4 of 12"	10
Pizza (cheese, meat, and veg.)	1/4 of 12"	17
Quiche	1/8 of 8" pie	22
Quiche (with bacon)	1/8 of 8" pie	22
Submarine Sandwich	3-4"	10
Taco	1 small	22

Name: \_\_\_\_\_

Looking at Lab Sheet N-2B, your kcalorie intake log, how much calcium do you consume in a day? Did you consume enough on the day you kept your intake log? Write your meals and servings with the amount of calcium in each below.

## Calcium Intake

TIME	FOOD	NUMBER OF SERVINGS	% OF U.S. RDA CALCIUM
(INCLUDE ALL MEALS AND SNACKS)			TOTAL % RDA

## TEACHER INFORMATION SHEET

The foods we eat contain a variety of vitamins, minerals, and other nutrients to keep our bodies healthy. All of these nutrients are needed in balanced proportion. One nutrient in particular--calcium--is needed for strong bones. Calcium deficiency can contribute to the loss of bone tissue, also known as osteoporosis. Osteoporosis often progresses without any symptoms until the loss of tissue leads to a painful fracture.

The body's demand for calcium is greater during certain stages of life. During childhood and adolescence, bone is rapidly growing in length, width, and density. Teenage girls and young women often do not consume enough calcium and do not get enough of this mineral for their bones. As adults, these women are likely to have a lower peak bone mass (maximum bone density and strength) than women who have had a good calcium intake. Also, when a woman is pregnant, her need for calcium increases because the baby needs its own calcium to form bones.

The average amount of calcium in the diets of North American women ranges from approximately 500 to 650 mg per day, while the range for men's diets is 800 to 900 mg per day. About 25% of women consume less than 300 mg per day. So women's diets tend to lack adequate calcium, while men's do not. Men eat more food in general to support their higher kcalorie expenditures, which accounts for part of the difference. An easy way for women to increase calcium intake is to increase activity level and in turn increase their food consumption.

## Lesson Eight: "Water - The Drink of Life"

**TIME:** One 45-minute class



**OBJECTIVES:** The Student will:

1. Collect data on food water content;
2. Record daily activities and calculate actual water loss; and
3. Determine optimum water intake for oneself.

### **MATERIALS AND EQUIPMENT:**

one raw potato per student or small group  
 balance scale  
 food processor or blender  
 measuring cup  
 strainer  
 spoon  
 calculator (optional)

### **PREPARATION:**

Obtain necessary materials  
 Read N-8A, Teacher Information Sheet

### **PROCEDURE A:**

1. Students will weigh a raw potato.
2. Chop the potato into chunks and puree in a food processor or blender.
3. Drain the liquid obtained from the process and measure.
4. Students will weigh the liquid.
5. Have students calculate the percentage by weight of the water content of the potato.

### **PROCEDURE B:**

1. Have students prepare a daily log of how much water they drink in one day, one week, or one month. Keep the measurements in ounces or liters.
2. Have students calculate how much water the body loses in the same amount of time based upon the average of 2.5 quarts (2.3 liters) per day.
3. Have students compare intake to output.
4. Discuss personal behavior modification to reach optimum water intake for good health.

### **EVALUATION:**

1. Completion of the potato exercise.
2. Completion with accuracy of the water intake log.
3. Completion of a personal modification plan for water intake.

**RESOURCES:**

1. Finn, S. The Real Life Nutrition Book. Penguin Books, New York, 1992.
2. Kowtalak, H. Food for Today. Glencoe Publishing Company, New York, 1994.
3. Learning to Like Me; a Resource Guide. Dairy and Nutrition Council Mid East, Columbus, Ohio, 1994.
4. Water! AAY826. 1995 Films for the Humanities and Sciences. P.O. Box 2053, Princeton, NJ 08543. 1-800-257-5126. Fax # 609-275-3767.

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## TEACHER INFORMATION SHEET

Our bodies need many nutrients, including water. A regular supply of water allows us to carry on life-supporting activities. In fact, you may be able to live for a few weeks without food, but the body can only exist a few days without water. Why is this? Perhaps because the body is composed of 50% to 70% water. Even your bones contain water and your blood is 80% water.

Besides the large contribution water plays in the make up of our bodies, this wonder liquid is important in the many chemical reactions that constantly go on in the body. For instance, water helps maintain body temperature. It transports nutrients and waste. Water also lubricates the digestive tract and other body tissues and is required for digestion. Lastly, water cushions the joints and spinal cord.

### WHERE DOES OUR BODIES GET WATER?

Beverages and foods are dietary sources of water. On the average, people consume about 4 cups of water daily in the form of beverages such as milk, juice, soft drinks, coffee, and tea. Additional water is supplied by food. For example, fruits are about 80% - 95% water. Bread is 37% water and beef is 47% water. Water is also a by-product of chemical reactions that occur in the body.

### HOW MUCH WATER DOES OUR BODIES NEED?

The recommendation for water for an adult is about 1 ml per calorie of energy burned. A person who consumes 2000 calories needs 2000 ml (2 liters) of water daily. This is about 8 cups. Exercise, illness, and exposure to the elements increase the body's need for water.

### IMPORTANT HEALTH TIP

Do NOT wait until you are thirsty to drink water. By that time your body has already lost a quart of water or more!

## OPTIONAL LESSON NINE: "The Burning Question"

**TIME:** four or more 45-minute class periods: one class period for pre-lab explanation, two or more lab periods for use of calorimeters, and one class period for post-lab calorie calculations and discussion.

**Note to Teacher:** This lab is recommended for middle school age children or older. It requires a certain level of competence with regard to motor skills, namely, in the use of the centogram scale and in igniting food with matches. The teacher must be able to trust students to follow directions.

The teacher will need to spend some time preparing several calorimeter sets, one for each lab group. The expense and quantities of the equipment may be cost prohibitive for elementary schools (see preparation).

Points to emphasize in post-lab:

1. These "homemade" calorimeters are not as accurate as the professional "bomb calorimeter."
2. Student results will be one-third to one-half the Kcal values as found in diet calorie charts.
3. Many substances will yield calories (e.g. paper) but are not digestible by humans.

**During the lab activity:** Some students can create an interesting way to burn vegetable oil: form a spoon-shaped vessel with aluminum foil and use kite string as a wick at the spoon's edge. Soot will appear on the outside of the test tube. This soot will not interfere with the efficiency of the calorimeter; however, the soot may obstruct the reading of the thermometer.

**Some foods to avoid and why:**

- very thin foods such as cornflakes and potato chips may be too brittle to withstand the puncture of a dissecting needle;
- fresh bread and cakes are too moist to stay lit;
- gum and many soft candies melt the probe;
- most protein foods (salami, etc.) release unpleasant odors; and
- spaghetti and macaroni noodles are too compact to stay lit.

**OBJECTIVES:** The Student will:

1. Participate in the use of the calorimeter;
2. Accurately collect data from Lab Sheet N-9B; and
3. Complete the post-lab Worksheet N-9C.

**VOCABULARY:** on the lab instructions

## **MATERIALS AND EQUIPMENT:**

homemade calorimeter  
Celsius thermometer  
test tube (20 x 150 mm)  
centogram balance (hundredths)  
graduated cylinder (25ml)  
dissecting needle/probe  
whole peanuts and other dry food from home  
matches  
goggles  
oversized stopper  
ring stand and clamp  
Lab Sheets N-9A, N-9B, and N-9C.

## **PREPARATION:**

Tin cans (such as soup, vegetables, or fruit cans) or aluminum coated paper cans (such as Pringles) may be shaped into a calorimeter as shown on Lab Sheet N-9A. Tin cans require tin snips in order to cut the metal. The sharp edges will need to be filed.

If students follow directions, then the temperatures of the water in the calorimeter should not reach 80 degrees, which is the safe limit for alcohol thermometers. Mercury thermometers are to be preferred to alcohol; however, the mercury creates a greater environmental hazard if they should break.

In this lab the function of the one-hole stopper is to hold the thermometer at the appropriate distance into the water in the test tube. The function is not to seal the test tube. Therefore, we recommend that you sacrifice the stopper by cutting a vertical slit from the outer edge to the hole inside the stopper. This will facilitate the removal of the thermometer and adjustment of its position up or down. Additionally, this slit will provide for the escape of "steam," thereby preventing the dangerous buildup of pressure inside the test tube, should the student exceed temperatures of 80 degrees.

The calorimeter will be "top heavy" and will require the use of a ring stand and clamp to hold up the test tube. Do not rely on the calorimeter to grip the test tube. Be prepared to replace broken test tubes and thermometers.

The seed of one Virginia peanut contains enough substance for a group to run the three sample tests of two-tenths gram each. A triple beam balance may not be accurate enough to weigh such small samples; it is for this reason that centogram scales are listed in the materials. Students should be encouraged to bring their own foods to test from home.

1. Duplicate copies of Lab Sheets N-9A, N-9B, and N-9C.
2. Obtain a photograph or diagram of a "bomb calorimeter" for post-lab discussion. Photographs are found in most biological supply house catalogs.

## PROCEDURE:

### PRE-LAB (first 45-minute class)



1. Distribute Lab Sheet N-9A and discuss the Introduction.
2. Show the "homemade" calorimeters with which the students will be working and review its design.
3. Illustrate or discuss each of the steps in the procedures on the lab sheet. Extra time should be spent discussing procedures in using a centogram scale.
4. Discuss various ways to strike a match and use safety precautions associated with spent matches. The food will ignite faster when the match flame is placed below the food. Burnt food needs to be placed on fire-resistant surfaces to cool.
5. Explain to students your expectations with regard to bringing food from home. Discuss which foods would be best and the quantities needed.

### CALORIE LAB DAYS (at least two 45-minute classes)



1. Facilitate students' use of equipment.
2. Match books are not given to students until they have followed procedures up to Step 6 on N-9A. Replacement of matchbooks is done when students bring the empty book to the teacher.
3. Students should postpone calculations to be made on the data chart N-9B at letter G and below.

### POST-LAB ACTIVITIES (one 45-minute class)



1. Distribute Worksheet N-9C.
2. Discuss and show examples of the steps in calorie calculations.
3. Discuss the remainder of the worksheet with students after they have completed the calculations on N-9B.

## EVALUATION:

1. Completion of Lab Sheets N-9A, N-9B, and N-9C.

## RESOURCES:

1. High School Science Teachers
2. Cooper K, *Kid Fitness*, Bantam Books, NY, 1991.
3. Dairy Council of Wisconsin, 999 Oakmont Plaza Drive, Suite 510, Westmont, IL 60559; 1-800-325-9121.
4. Dietician/nutritionist, local cooperative extension agent in your county, counselor from local eating disorders clinic.
5. "Food Models," National Dairy Council, 1990. ISBN 1-5564-7042-6.
6. Human Nutrition Information Service, U.S. Department of Agriculture, 6505 Belcrest Road, Hyattsville, MD 20782. Ask for a variety of information.

NAME: \_\_\_\_\_

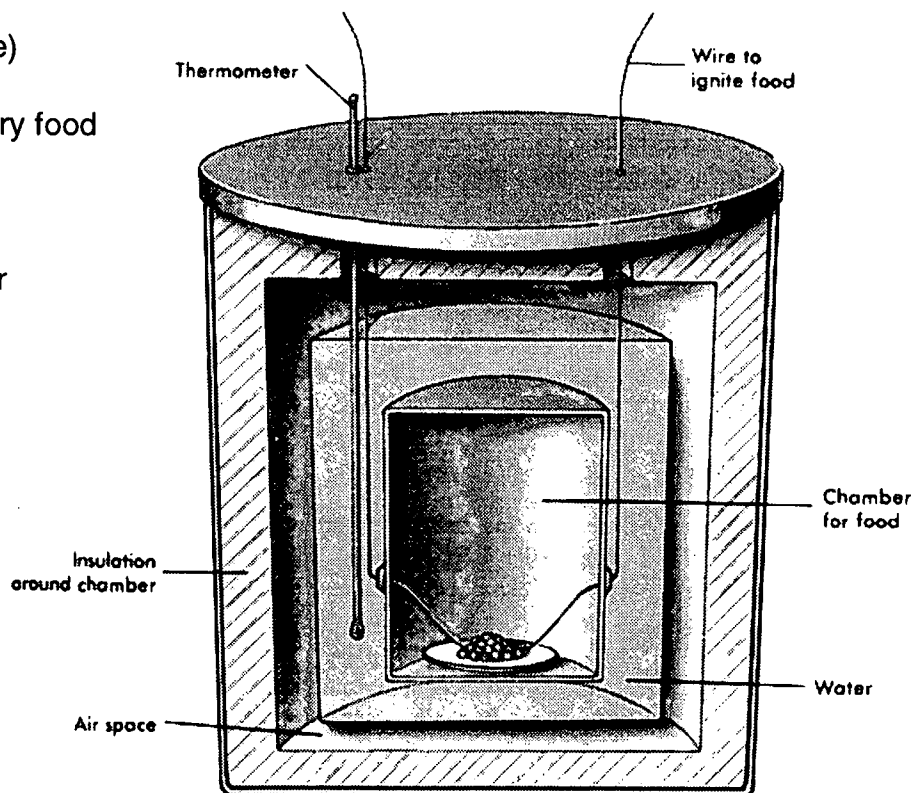
**THE BURNING QUESTION**

## Calorimeter Lab

**INTRODUCTION:** Advertising makes us aware that some foods provide us with “energy.” There is much confusion about the amount of energy that a food contains and how much or how soon the body could extract energy from these foods. Do equal amounts of different foods contain the same amount of energy? Which has more energy: one gram of oil or one gram of starch? In this lab activity you will use a calorie measurement instrument (calorimeter) to answer the above questions. A calorie is the amount of heat required to raise the temperature of 1 gram of water 1 degree Celsius. Calorie values of foods in diet charts are listed in terms of kilocalories (kcal) and are actually equal to 1,000 calories. Sometimes the diet calorie (kcal) is spelled with a capital “C.” We will be comparing your lab results with the accepted caloric values from diet charts. Your experimental design is based on the principle that heat energy released by a known amount of a substance when it is burned may be transferred to a measured amount of water. In turn, the water temperature rise can be determined with a thermometer.

**MATERIALS AND EQUIPMENT:**

homemade calorimeter  
ring stand and clamp  
Celsius thermometer  
dissecting needle (or probe)  
test tube (20 x 150 mm)  
whole peanuts and other dry food  
centogram balance  
graduated cylinder (25 ml)  
matches  
oversized one-hole stopper  
goggles  
Lab Sheet B- 9B



**PROCEDURE:**

1. Weigh three peanut samples of 0.20 gram each. (Weights between 0.18 to 0.23 are acceptable) Record the exact weights on data chart N-9B on line "C."
2. Place 20 ml of water into the test tube.
3. Measure the temperature of the water. Record it in the data chart line "E" ...temperature of water before burning.
4. Take one of the peanuts and stick it on the point of the dissecting needle.
5. Before striking the match, put on your goggles.
6. Light the peanut. When it begins to burn, immediately place it inside the calorimeter directly under the test tube with a little space for the flame.
7. If the peanut does not burn completely, you may need to re-light the peanut. When it has burned completely, allow a few seconds for the test tube to warm the water and the thermometer. Record the new temperature in the data chart on line "F" ...temperature of water after burning.
8. Change the water in the test tube.
9. Repeat Steps 1-8 for the second and third peanut samples.
10. Repeat the above steps with the other foods brought from home.

NAME: \_\_\_\_\_

Lab Sheet N-9B

# CALORIMETER LAB DATA CHART

A. Name of Food:

B. Trial Number	1	2	3	1	2	3	1	2	3
C. Weight of food (in grams)									
D. Amount of water (ml)									
E. Temperature of water before burning									
F. Temperature of water after burning									
G. Temperature difference									
H. Calories from food burnt									
I. Calories per gram									
J. Calories (kilo-calories) per gram									

NAME: \_\_\_\_\_

Post-lab Worksheet N-9C Page 1

## THE BURNING QUESTION

Your data chart for the Calorimeter lab can be completed by making these calculations:

$$\text{Line G} = \frac{F}{-E}$$

$$\text{Line H} = \frac{G}{xD}$$

$$\text{Line I} = H \text{ divided by } C$$

$$\text{Line J} = I \text{ divided by } 1,000$$

When you have completed your calculations, do not average the answers.  
The best answer is the highest you were able to obtain for each food tested.

1. List the foods you used in the calorimeter lab in order of decreasing energy value.
2. What nutrient probably makes the best energy source? (circle one)  
sugar      starch      fat/oil      protein
3. Compare your calorie results to those listed on the Calorie charts provided in class.  
Are your results generally higher or lower than those given on these charts?
4. Make a comparison between your "homemade calorimeter" and a professional "bomb calorimeter":

In what way is the food ignited?

In what way is the burning food supplied with oxygen?

In what way is the heat from the food captured?

5. List some human caused errors that could occur during the calorimeter experiment which would affect the data:
  - a.
  - b.
  - c.
  - d.



6. As far as vegetables are concerned, the potato is not exceptionally high in calories. However, diet-conscious people claim that potatoes can be “fattening.” Explain why potatoes should or should not be considered “fattening.”
  
7. Why might some foods without as much energy be better energy foods than those which test higher in calories? Compare:
  - a. glucose
  - b. cellulose (fiber)
  - c. alcohol
  
8. Why do we eat some foods that give us little energy?

NAME: \_\_\_\_\_

"Answer Key" N-9D Page 1

## THE BURNING QUESTION

Your data chart for the Calorimeter lab can be completed by making these calculations:

$$\text{Line G} = \frac{F}{-E}$$

$$\text{Line H} = \frac{G}{xD}$$

$$\text{Line I} = \text{H divided by C}$$

$$\text{Line J} = \text{I divided by 1,000}$$

When you have completed your calculations, do not average the answers. The best answer is the highest you were able to obtain for each food tested.

- List the foods you used in the calorimeter lab in order of decreasing energy value.  
*Nutmeats, such as the peanut, are highest because of their oil content. Starchy foods usually burn easier than sugars and proteins even though the actual calorie values are similar.*
- What nutrient probably makes the best energy source? (circle one)  
sugar      starch      fat/oil      protein (*fat/oil is "best" in the sense that it has most calories per gram*)
- Compare your calorie results to those listed on the Calorie charts provided in class. Are your results generally higher or lower than those given on these charts? *The students' results will be lower because of design flaws in a homemade calorimeter.*
- Make a comparison between your "homemade calorimeter" and a professional "bomb calorimeter":  
In what way is the food ignited? *In the homemade calorimeter, with a flame from a match; in the bomb calorimeter, with an electric spark.*  
In what way is the burning food supplied with oxygen? *In the homemade calorimeter, the air in the room is approximately 20% oxygen. In the bomb calorimeter, tanks of pure oxygen are used.*  
In what way is the heat from the food captured? *In the homemade calorimeter, burning food heats up a test tube, which in turn heats up the water. This is very inefficient, compared to the bomb calorimeter, where an insulated water bath surrounds the burning food, and no heat is lost.*
- List some human caused errors that could occur during the calorimeter experiment which would affect the data: *Some possibilities include:*
  - Errors in measuring the weights, volumes, or temperatures.*
  - Incomplete combustion of food not perceived by students.*
  - Calories wasted/lost when burning food is not under test tube quickly enough.*
  - Student could be impatient and read temperatures before they have peaked.*

6. As far as vegetables are concerned, the potato is not exceptionally high in calories. However, diet-conscious people claim that potatoes can be "fattening." Explain why potatoes should or should not be considered "fattening." *Potatoes are not fattening. However, how they are prepared, or what we put on them, can be fattening. The potato is an essential starch. French frying the potato adds oil. Butter, sour cream, and cheese sauces are also high in fats. (Salt does not have calories.)*
7. Why might some foods without as much energy be better energy foods than those which test higher in calories? Compare:
- a. glucose: *A simple molecule, ready for cells to be oxidized and put to use.*
  - b. cellulose (fiber): *Humans lack the enzymes to break the molecule down to glucose; therefore the calories in cellulose are never released.*
  - c. alcohol: *Our body actually spends energy to detoxify this poison.*
8. Why do we eat some foods that give us little energy? *Because we like the flavors, as in coffee or tea, or the textures, as in crunchy lettuce or celery, or the stimulus of caffeine in coffee or soda. Because foods contain fiber which contribute to bowel movement regularity. Because we recognize the value in certain vitamins. Other similar expressions would be acceptable.*

## RESOURCES FOR MODULE 3: NUTRITION

### Strongly Recommended:

Barbera-Hogan M, "Love Food, Hate Food," Under 25, Vol.3, No.3, Winter, 1992.

Cooper K, Kid Fitness, Bantam Books, NY, 1991.

Dairy Council of Wisconsin, 999 Oakmont Plaza Drive, Suite 510, Westmont, IL 60559; 1-800-325-9121.

Dietician/nutritionist, local cooperative extension agent in your county, counselor from local eating disorders clinic.

"Food Models," National Dairy Council, 1990. ISBN 1-5564-7042-6.

Human Nutrition Information Service, U.S. Department of Agriculture, 6505 Belcrest Road, Hyattsville, MD 20782. Ask for a variety of information.

"Pyramid Power: Snack Appeal, Learning from Advertisements," Ohio Department of Education, Nutrition Education and Training, 65 S. Front Street, Columbus, OH 43266.

Wardlaw G and Insel P, Perspectives in Nutrition, Times Mirror, Mosby Pub, St. Louis, 1990. ISBN 0-8016-2847-4.

### Other Resources:

Eating Disorders Awareness and Prevention, 150 Guernsey Road, Swarthmore, PA 19081. (215) 544-1725.

Hyman J, The Fitness Book, Julian Messner Pub., NY, 1984. ISBN 0-6714-6433-7.

Kane J, Coping With Fad Diets, Rosen Pub. Group, Inc., 1990. ISBN 0-8239-1005-9.

Karlsberg E, Eating Pretty, Troll Associates, Mahwah, NJ, 1991. ISBN 0-8167-2002-9.

Kowtaluk, H and Kopan, A. Food for Today. Macmillan/McGraw-Hill, Peoria, Illinois, 1994. ISBN 0-0267-6110-6.

Kuntzleman C, Healthy Kids for Life, Simone & Schuster, NY, 1988. ISBN 0-671-60742-1.

Learning to Like Me. Dairy & Nutrition Council Mid East, 1993.

Leneman L, Slimming the Vegetarian's Way, Thorsons Pub., 1980. ISBN 0-7225-1587-1.

Marx R, It's Not Your Fault, Villard Books, NY, 1991. ISBN 0-3945-7402-8.

National Anorexic Aid Society, 1925 Dublin Granville Road, Columbus, OH 43229.  
(614) 436-1112.

Ohio Health Promotion Network, Bureau of Health Promotion and Education, Ohio Department of Health, P.O. Box 118, Columbus, OH 43266-0118. (614) 644-7852. Various educational materials.

Pennington J, Food Values of Portions Commonly Used, 15th ed., Harper Perennial, NY, 1989. ISBN 0-06-273156-4.

READ THE LABEL, Focus on Food Labeling, An FDA Consumer Special Report, May 1993.

Rodd M, Fear of Fat: Dieting and Eating Disorders, Churchill Films, 662 W. Robertson Blvd., L.A., California 90069-5089. (310) 207-6600.

Salter C, The Vegetarian Teen, Millbrook Press, Brookfield, Conn. ISBN 1-5629-4048-1.

Sanchez G, Overeating. Let's Talk About It, Dillon Press, Inc., Minneapolis, MN., 1986. ISBN 0-8751-8319-0.

Sexias J, Junk Food - What It Is, What It Does, Greenwillow, 1984. ISBN 0-6880-2559-5.

Silverstein A & V, So You Think You're Fat, Harper Collins, NY, 1991. ISBN 0-06-021641-7.

Try Foods International, Inc., P.O. Drawer 2248, Apopka, FL 32704. 1-800-421-0809.

Ward B, Diet and Health, Franklin Watts Pub., NY, 1991. ISBN 0-5311-4095-4.

## MODULE 4: EXERCISE PHYSIOLOGY

Exercise physiology is the study of the effects of exercise on the human body both chemically and physically. The lessons in this module were developed to help the Student understand the importance and benefits of a healthy, active lifestyle.

In this module the Student will:

Lesson One:

- (a) Simulate different heart rates and discuss why the rate changes.
- (b) Explain health behaviors that strengthen or weaken the heart muscle.

Lesson Two:

- (c) Take and record his/her pulse and blood pressure.

Lesson Three:

- (d) Compare and analyze individual pulse rates before and after exercise.

Lesson Four:

- (e) Demonstrate knowledge of the pro's and con's of steroid use/abuse.

Lesson Five:

- (f) Analyze samples of normal and abnormal simulated urine.

Lesson Six:

- (g) Explain the role of exercise in preventing osteoporosis.
- (h) Assess personal physical fitness according to basic good health standards.
- (i) Set goals for personal improvement in his/her physical condition.

## LESSON ONE: "We're Here to Pump You Up"

**TIME:** one 45-minute class



**OBJECTIVES:** The Student will:

1. Simulate different heart rates, and explain why the rate changes; and
2. Explain health behaviors that strengthen the heart muscle.

### VOCABULARY:

cardiac muscle: involuntary heart muscle; these muscles work constantly without tiring

smooth muscle: involuntary muscle; muscles that contract and relax on their own

striated muscle: voluntary skeletal muscle; people control movement of these muscles

target heart rate: the ideal heart rate to be achieved during exercise

### MATERIALS AND EQUIPMENT:

stopwatch or clock with second hand

metronome

Lab Sheet E-1A

calculators

### PREPARATION:

1. Duplicate Lab Sheet E-1A, one per student.
2. Become familiar with the following information about target heart rate and the heart.

The heart beats in order to pump blood, carrying oxygen through the body. When a person exercises, he or she needs more oxygen, so the heart must pump faster in order to supply that oxygen. Reaching the "target heart rate" three times a week for 30 minutes is desirable because it gets the heart "in shape" to best do its job. When the heart is in good condition, it can pump more blood with each beat. This is why athletes have lower resting heart rates than nonathletes.

The formula on Lab Sheet E-1A tells students how to determine their target heart rate. Students will then need to discuss ways to reach that target heart rate through exercise. Some examples of aerobic exercise are: walking, running, aerobics, bicycling, rollerblading and ice skating. Encourage them to come up with a realistic plan for conditioning their hearts.

### PROCEDURE:

1. Give students the following instructions: Begin with your fingers spread wide apart. At the count of one, make a fist as tightly as you can. This represents the contraction (or squeezing) of the heart; the heart is at work. At the count of two, open your fingers wide. This represents the heart at rest.
2. Set metronome at 60. Have students open and close their hands at one second intervals for one minute.
3. Ask them how their fingers feel; unlike fingers, the heart has to keep working all the time. Ask them what would happen if the heart became tired and stopped.
4. Discuss what the heart does, and what is happening when it is working.

5. Discuss exercise and its effect on the heart.
6. Set metronome at 180. Have the students open and close their hands 180 times for one minute.
7. Ask them how their fingers, hands, and forearms feel. Ask, "Is your hand designed to work like this continuously? Is your heart designed to work this way?"
8. Discuss the various types of muscle.
9. Discuss target heart rate.
10. Assign Lab Sheet E-1A.

Optional:

11. Have students calculate the target heart rate of "family" members.
12. Have students calculate the number of heartbeats saved in a day, week, month, or year when the heart rate is reduced as a result of regular exercise.

#### **EVALUATION:**

1. Completion of Lab Sheet E-1A.

Optional:

2. Completion of Steps 11 and 12, above.

#### **RESOURCES:**

1. Cooper K, Kid Fitness, Bantam Books, NY, 1991, pp. 137-42.
2. exercise physiologist from local educational institution (sports trainer) or sports medicine facility.
3. American Heart Association: 1-800-282-0291.
4. Parker S, The Skeleton and Movement, Watts Pub., NY, 1991, pp. 24-45.
5. Meeks L, and Heit P, Comprehensive School Health Education: Totally Awesome Strategies for Teaching Health, MeeksHeit Publishing Co., Inc., Blacklick, OH, 1992.

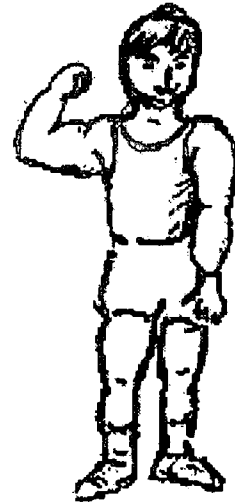


NAME: \_\_\_\_\_

## WE'RE HERE TO PUMP YOU UP

What is the difference between the muscles in your hand and your heart muscle?  
(Remember: Opening and closing your hand.)

Why do you think this difference exists?



Calculate your individual target heart rate.

$(220 - \text{your age}) \times 0.75 =$  \_\_\_\_\_ target heart rate

Develop an exercise plan that will allow you to reach your target heart rate three times a week for thirty minutes.

## LESSON TWO: "I Can Count On You"

**TIME:** one 45-minute class



Note to Teacher: Abnormal pulse rate is not uncommon in preadolescent and adolescent students. Check with your school nurse and/or child's medical record before mentioning any perceived abnormalities in a child's pulse rate or blood pressure.

**OBJECTIVES:** The Student will:

1. Take and record his/her pulse and blood pressure at rest.

### VOCABULARY:

blood pressure: pressure exerted on the arterial walls

diastolic: pressure exerted by blood on the arterial walls when the heart is at rest (filled with blood)

pulse: the expansion and relaxation that can be felt in an artery each time the heart contracts and relaxes

systolic: pressure exerted by blood on the arterial walls when the heart contracts (forcing blood out of the heart)

### MATERIALS AND EQUIPMENT:

sphygmomanometer - regular and pediatric (blood pressure cuff)

Lab Sheet E-2A

video or film on exercise from the American Heart Association

### PREPARATION:

1. Contact trained health professional to assist with taking the students' blood pressure.
2. Duplicate Lab Sheet E-2A, one per student.
3. Contact American Heart Association for film or video.

### PROCEDURE:

1. Distribute Lab Sheet E-2A.
2. Take students' blood pressures (school nurse, parents working in health professions may assist). Show film/video while blood pressures are taken.
3. Complete Lab Sheet E-2A.

### EVALUATION:

1. Accurate completion of Lab Sheet E-2A.

### RESOURCES:

1. trained health professional
2. American Heart Association: I am Joe's Heart: New Version. 10 minute video. 1-800-282-0291.
3. American Heart Association: Kids At Heart. 25 minute video. 1-800-282-0291.
4. Cooper K, Kid Fitness, Bantam Books, NY, 1991, pp. 296-301.

NAME: \_\_\_\_\_

## I CAN COUNT ON YOU

1. Measure pulse rate by counting for 10 seconds, then multiplying it by six. Repeat the same procedure two more times, and record your results.

1st rate \_\_\_\_\_

2nd rate \_\_\_\_\_

3rd rate \_\_\_\_\_

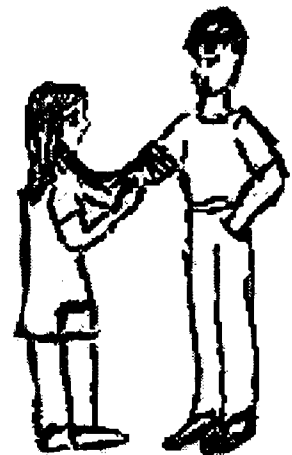
\_\_\_\_\_ Total

2. Find your average pulse rate.  $\text{Total} \div 3 = \text{average}$

\_\_\_\_\_  $\div 3 =$  \_\_\_\_\_

3. Have your blood pressure taken and record the rate \_\_\_\_\_

Record the Date: \_\_\_\_\_ and Time: \_\_\_\_\_



### LESSON THREE: "Pump It Up"

**TIME:** one 45-minute class

**OBJECTIVES:** The Student will:



1. Compare his/her individual pulse before and after exercise;
2. Analyze the results of the collected data; and
3. Know her/his individual level of recovery after exercise.

#### **VOCABULARY:**

recovery rate: the time it takes the heart to return to its resting rate

resting heart rate: how fast the heart beats when a person is sitting still

#### **MATERIALS AND EQUIPMENT:**

graph paper (Appendix B)

Lab Sheet E-3A

stopwatch or clock with second hand

step or chair

metronome

#### **PREPARATION:**

1. Locate step or chair with proper height for Step test and obtain stop watch and/or metronome.
2. Duplicate Lab Sheet E-3A and graph paper, one each per student.
3. Review Lab Sheet E-3A prior to lesson.

Optional:

4. Three minutes of jumping jacks or jogging may be substituted for the Step test.

#### **PROCEDURE:**

1. Distribute Lab Sheet E-3A.
2. Divide the class into pairs.
3. Complete Lab Sheet E-3A.
4. Have students graph individual results of Lab Sheet E-3A as a bar graph.
5. Discuss results and implications of the activity.
6. Ask students for recommendations to improve their recovery rates.

#### **EVALUATION:**

1. Completion of Lab Sheet E-3A and bar graph.
2. Student self-assessment.

#### **RESOURCES:**

1. Regents of the Univ. of California, "Jog-Walk," Health Activities Project, 1976.
2. Examples of other exercise plans to increase aerobic fitness.

NAME: \_\_\_\_\_

## PUMP IT UP - STEP TEST

To test the body's capacity to adapt to, and recover from, strenuous exercise.

Take your resting pulse rate and record. \_\_\_\_\_

This test taxes the respiratory - circulatory resources of the individual.

While working in pairs, one student holds the chair while the other student completes the following directions.

1. Use platform 14 to 20 inches high. Step 30 times per minute for three (3) minutes.
2. Start by placing left foot on the platform at the command UP. Then step up with other foot, so both feet are on the platform. Then step down, using the same rhythm.

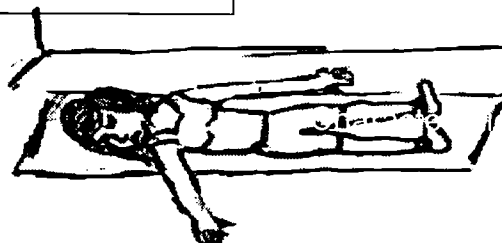
Use a marching count-up-two-three (down)-four. The signal UP comes every two seconds.

Exercise for three minutes, then sit down and remain quiet.

1. One minute later take the pulse rate for 30 seconds. Record \_\_\_\_\_
2. Rest for 10 seconds. Then take pulse for 30 seconds. Record \_\_\_\_\_
3. Rest for 10 seconds. Then take pulse for 30 seconds. Record \_\_\_\_\_
4. Add total of all three 30 second counts. Total \_\_\_\_\_
5. Determine your individual level of recovery. My response is \_\_\_\_\_

## RECOVERY INDEX

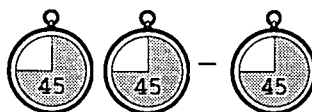
TOTAL	YOUR RESPONSE IS:
199 or more	poor
171 to 198	fair
150 to 170	good
133 to 149	very good
132 or less	excellent



141  
129

## LESSON FOUR: "Muscle Bound"

**TIME:** two to three 45-minute classes



**OBJECTIVE:** The Student will:

1. Demonstrate knowledge of the pro's and con's of steroid use/abuse.

### VOCABULARY:

anabolic steroid: synthetic version of the male hormone testosterone

cycling: taking multiple doses of steroids over a specific period of time, stopping for a time and starting again

stacking: using a combination of anabolic steroids, often in conjunction with other drugs

testosterone: the hormone which controls the development of masculine characteristics

### MATERIALS AND EQUIPMENT:

Information Sheets E-4A through E-4E

variety of additional educational resources pertaining to anabolic steroids

### PREPARATION:

1. Become familiar with Information Sheets E-4A through E-4E. Copy for students.
2. Obtain resource materials; students may assist.

### PROCEDURE:

1. Discuss information on steroid use/abuse. If desired, use local resource person and/or video pertaining to steroid use (video should be previewed prior to class).
2. Have students work individually or in small groups on any of the following activities:
  - (a) Develop and play a game of choices and consequences of steroid use;
  - (b) Debate the pros and cons of steroid use (fairness in competition);
  - (c) Write and present a play (drama);
  - (d) Create and display comic strips (factual);
  - (e) Interview medical personnel, coaches, athletic trainers, and athletes;
  - (f) Design informal posters (factual);
  - (g) Compile a book of articles (newspapers, magazines, etc.); and/or
  - (h) Write public service announcements and news articles.

### EVALUATION:

1. Completion and presentation of chosen activities.

### RESOURCES:

1. US Food and Drug Administration, HFN-365, 5600 Fishers Lane, Rockville, MD 20857, (301) 443-2410.
2. American College of Sports Medicine, PO Box 1440, Indianapolis, IN 46206, (317) 637-9200.
3. Hotline 1-800-STEROID.
4. Nat'l. Clearinghouse for Alcohol and Drug Info., PO Box 2345, Rockville, MD 20852.
5. Nat'l Inst. on Drug Abuse, 5600 Fishers Lane, Rockville, MD 20857, 1-800-662-HELP.

NAME: \_\_\_\_\_

**MUSCLE BOUND****History of Anabolic Steroids**

Anabolic steroids were first developed in the 1930's originally to help men whose bodies did not produce enough testosterone. The steroids were to help them develop secondary male characteristics.

Reportedly, the first healthy people to use anabolic steroids were not athletes. Hitler's SS troops were given anabolic steroids to increase their aggressiveness in battle.

Anabolic steroids were first introduced into the sporting arena in the 1940's and 1950's. The Russian weightlifting team, in the 1952 Olympics, won a large number of the medals partly due to the use of synthetic testosterone. Following this development, the United States began researching the development of anabolic steroids. By 1958, a U.S. pharmaceutical firm had developed anabolic steroids. Although the physician soon realized the drug had many unwanted side effects, it was already too late to halt the spread of anabolic steroids into the sports world.

Doping, the taking of nonfood substances to improve performance, has been around since the ancient Greeks. Greek wrestlers used to eat huge amounts of meat to increase their muscle mass. The high protein content helped build muscle.

Norse warriors known as Berserkers used to eat hallucinogenic mushrooms to gear up for battle.

The first athletes charged with doping were swimmers in Amsterdam in the 1860's.

NAME: \_\_\_\_\_

Lab Sheet E-4B

## MUSCLE BOUND

### Methods of Use

- ORAL -** Anabolic steroids are most commonly taken in pill form. However, this means that the steroids need to pass through the digestive system. This allows the steroids to do more damage to the organs of the user, and they are especially damaging to the liver.
- INJECTION -** Since some steroids cannot be digested, they must be injected directly into the bloodstream. This method does reduce some of the damage to the liver; however, the users do run the risk of transmitting the HIV virus, hepatitis, and other diseases of the blood.
- DOSAGE -** The male body produces about 3 to 10 milligrams of testosterone each day. The normal medical dosage averages between 1 and 5 milligrams. The average reported dose for a competitive athlete is hundreds of milligrams each day. This far exceeds healthy medical doses. This method of taking large doses is called megadosing.
- STACKING -** Stacking is the taking of at least two different steroids at the same time in order to stimulate many different growth receptors. The belief is that this will help the person develop more muscle mass at a faster rate.
- CYCLING -** This is the taking of anabolic steroids in cycles. For example, six weeks on a drug followed by three weeks off of a drug. This allows the body to recover.



NAME: \_\_\_\_\_

# MUSCLE BOUND

## Side Effects

### PRO'S

- Better physical appearance
- Produce increased anabolic activity (greater muscular bulk)
- Added muscle strength and endurance
- The U.S. Food and Drug Administration has approved the use of selected anabolic steroids for the treating of specific types of anemia, some breast cancers, osteoporosis, endometriosis, and hereditary angioedema (a rare disease involving the swelling of some parts of the body).
- Treatment of severe burns
- Treatment of swelling
- Three studies have shown the potential of these drugs to increase total blood volume and hemoglobin and may suggest a positive effect of steroids on aerobic capacity. However, there has been no substantiation of the results in subsequent studies. Thus, the majority of evidence shows no positive effect of anabolic steroids on aerobic capacity over aerobic training alone.

# MUSCLE BOUND

## Side Effects

### CON'S

- Psychological damage:
  - depression
  - listlessness
  - aggressive, combative behavior ("roid rage")
  - anxiety
  - paranoia
  - psychologically addicted to steroids
  - disturbance of sleep patterns
- Damage to liver: jaundice, cancer, tumors, pelosis hepatitis.
- Damage to cardiovascular system: cholesterol modifications, heart disease, anaphylactic shock, death, high blood pressure, septic shock.
- Damage to reproductive system:
  - male:
    - decrease in size and function of testicles
    - sterility (damage is reversible)
    - lowered sperm count
    - prostate enlargement
    - growth of breast tissue
    - when steroid use ceases, there may still be an imbalance of testosterone levels
  - female:
    - genital swelling
    - menstrual irregularities
    - fetal damage (masculinization of female fetuses)
    - sterility
    - shrinkage of breasts

- Other physical side effects

- hairiness in women (irreversible)
- oily skin
- edema
- women develop male-pattern baldness (irreversible)
- diarrhea
- changes in bowel and urinary habits
- headache (continuing)
- excessive calcium
- kidney disease
- nausea or vomiting
- purple or red spots on body, inside mouth or nose
- unpleasant breath odor
- bone growth plates (epiphyses) stop growing thereby exposing athletes to risks because injuries (to ligaments and tendons) take longer to heal
- acne
- stunted growth
- bone pain
- abdominal pains
- chills
- gallstones
- hives/rash
- insomnia
- kidney stones
- muscle cramps
- unusual weight gain
- unexplained weight loss
- sore throat
- unusual bleeding
- irreversible deepening of female's voice

NAME: \_\_\_\_\_

**MUSCLE BOUND****Signs of Use**

- rapid muscle and weight gains
- behavioral changes: increased aggression and combativeness or a shift toward depression
- jaundice and/or unexplained darkening of the skin
- purple or red colored spots on the body, or hives
- swelling of feet or lower legs
- trembling
- acne
- persistent, unpleasant breath odor
- complaints of abdominal or stomach pains
- blurred vision
- sore tongue and/or sore throat
- chills and/or fever
- headaches
- light headedness
- muscle cramps
- hair loss
- puffy cheeks
- deepening of female's voice

NAME: \_\_\_\_\_

## **MUSCLE BOUND**

### **Legislation**

The U.S. Food and Drug Administration ordered Dianabol, an anabolic steroid, removed from the market in 1983. This decision was based on a lack of sufficient evidence that Dianabol was effective for any clinical use.

The U.S. Food and Drug Administration, Department of Justice, Federal Bureau of Investigation, and the U.S. Customs Service are coordinating enforcement activities to stop the steroid black market whose estimated value is \$100 million in illegal sales per year.

The Anti-Drug Abuse Act of 1988 makes it illegal for a physician to prescribe anabolic steroids to anyone for nonmedical reasons.

The Anabolic Steroids Control Act of 1990 requires pharmaceutical firms that are producing anabolic steroids to report to the U.S. Food and Drug Administration their total production amounts each year.

The American Medical Association condemns the use of anabolic steroids by athletes. Other medical associations have joined with the A.M.A. in deploring steroid abuse, including the:

- American Academy of Pediatrics
- American College of Sports Medicine
- American Osteopathic Academy of Sports Medicine

The International Olympic Committee banned steroid use by all athletes in its member associations in 1975. Since then, most major amateur and professional organizations have put anabolic steroids on their list of banned substances. They include:

- National Football League
- National Collegiate Athletic Association
- International Amateur Athletic Association
- International Federation of Body Builders

## LESSON FIVE: "What's Up, Doc?"

**TIME:** one 45-minute class



Note to Teacher: Examination of urine is useful in the diagnosis of several abnormal conditions in the body. It is a quick and easy procedure, but many factors can alter urine test strip readings; blood tests often are needed to more accurately diagnose ailments.

Urine is a complex matrix of ingredients. Some components normally fluctuate during the day (e.g. amino acids, pH). Therefore, the description of "normal" urine often is based on a 24-hour collection. Students may be informed that some conditions (other than those listed on Lab Sheet E-5D) which alter the composition of urine include: heart and glandular conditions; stress and emotions; dietary and vitamin intake; prolonged bed rest; reactions to transfusions; burns; certain forms of cancer and other diseases; poisoning from a variety of sources (e.g. mushrooms, heavy metal, and snake venom); and medications (e.g. antihistamines, painkillers, sulfa drugs, etc.).

The continual process whereby various internal organs provide stable levels of blood and urine constituents is called homeostasis. A fascinating example of the strength of the body's ability to maintain homeostasis is demonstrated in cases of anorexia or fasting beyond 20 days, in which the urine may have perfectly normal levels of all constituents.

In an effort to protect the Student's right to privacy and to avoid the fear of contact with diseases, we will analyze simulated urine. The advantages to this approach include: (1) odor will be eliminated; (2) abnormal conditions can be simulated without bacteria and interference factors which mask readings; and (3) the urine can be stored in advance of the lab activity for a period of time (unless it has abnormal conditions--see below).

**OBJECTIVE:** The Student will:

1. Perform routine procedures for analyzing normal and abnormal samples of simulated urine.

### VOCABULARY:

albumin: water-soluble proteins that occur in blood plasma or serum, muscle, the whites of eggs, milk, other organic substances; normally not excreted in the urine

anorexia: an eating disorder; difficult to diagnose by urinalysis because the body compensates for lack of food

dehydration: an abnormal depletion of body fluids

diabetes mellitus: a disorder characterized by inadequate secretion or utilization of insulin, excessive amounts of sugar in the blood and urine, thirst, hunger, and loss of weight

excretion: useless or harmful material that is eliminated from the body

homeostasis: a relatively stable state of equilibrium

glucose: a simple sugar widely found in nature, normally not excreted in the urine

ketone: a by-product of fat metabolism

pH: a measure that expresses both acidity and alkalinity on a scale whose values run from 0 to 14, with 7 representing neutrality; numbers less than 7 increasing in acidity, and numbers greater than 7 increasing in alkalinity

occult blood: blood cells not seen by the naked eye, but present in the urine

short-term fasting: abstaining from food; may cause an elevated ketone level, increased specific gravity, and the appearance of albumin in the urine

specific gravity: the ratio of the density of a substance to the density of pure water

urine: liquid waste material that is secreted by the kidneys

### **MATERIALS AND EQUIPMENT:**

simulated urine samples with abnormally high levels of ketone, sugar, pH, and specific gravity (purchased or prepared by the teacher)

urinary test strips (e.g. Chemstrips 6 or 7, Labstix 5, or Multistix 7) which include measurements for at least glucose, ketone, pH, protein, and occult blood

one clinical refractometer or one hydrometer and graduated cylinder

table salt

fresh egg white or powdered albumin

interstitial fluids (bloody juice from fresh meat)

diluted hydrochloric acid (HCL) - small amount

red and yellow food coloring

household ammonia

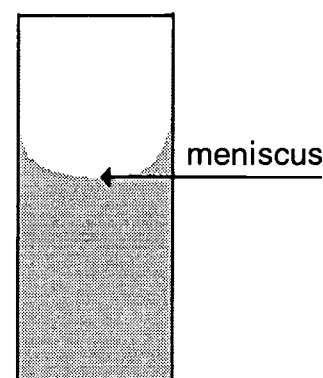
3 ml acetone

3 dropper bottles per group

paper towels

Lab Sheets E-5A through E-5F

simulated urine (prepare using Lab Sheet E-5F)



### **PREPARATION:**

1. Become thoroughly familiar with Note to Teacher.
2. Decide if you're going to use purchased simulated urine (approximately \$10/pint) or whether you will prepare simulated urine (less than \$1/quart). If you purchase simulated urine, it is available from biological supply houses. **Note:** Even though acetone is a ketone, some test strips will not read this ketone alone. Therefore, simulating ketone is not always practical.
3. Purchase or prepare simulated urine for normal and abnormal conditions (see Lab Sheet E-5F). **Note:** The abnormal conditions contain organic materials which have a short storage life. Use immediately for best results.
4. Purchase or obtain urinalysis test strips so that the lab activity is performed before the expiration date.
5. Become familiar with the urinalysis test strips.
6. Review the Pre-lab Discussion with students before conducting the lab and review pertinent terms from the vocabulary.
7. If a urine hydrometer is used for measuring specific gravity, then the following technique should be explained:
  - (a) Fill the graduated cylinder to 3/4 capacity before inserting float;
  - (b) Read the bottom of the meniscus; (see above)
  - (c) Keep the urine hygrometer from touching the wall of the cylinder; and
  - (d) Thoroughly rinse after each use.

8. If a clinical refractometer is used for measuring specific gravity, then explain the following technique:
  - (a) Standardize the scale with distilled water;
  - (b) Add two drops of simulated urine to the refractometer;
  - (c) View towards light; and
  - (d) Thoroughly rinse after each use.
9. Duplicate Lab Sheets E-5A, E-5B, and E-5D, one each per student.

### PROCEDURE:

1. Hold pre-lab discussion with students:
  - (a) Urinalysis is a quick and easy way to screen for abnormalities/conditions; it is not the only way to determine ailments.
  - (b) We will not be using real urine specimens in this lab; the simulated urine was artificially made to contain sterile minerals. It will show reactions found in diseased persons, but no disease is actually in the solution.
  - (c) Urine is very complex. It normally contains many constituents. About 20 ingredients are in quantities high enough to be tested. We will concern ourselves with less than a dozen constituents.
  - (d) If you do not have normal color vision, have your lab partner "read" or interpret the colors on the strip.
2. Use either the refractometer or urine hydrometer to determine the specific gravity of each specimen, as demonstrated by the teacher. Clean the equipment after each use.
3. Obtain labelled dropper bottle of each urine sample A, B, and C.
4. Lay the test strip on a paper towel with the color squares facing up and the strip handle away from you.
5. Place one drop of specimen A on only one square; wait the appropriate time (see directions given by the manufacturer of the test strip) and compare the color on the strip with the chart given on the test strip canister. Record results on Lab Sheet E-5A.
6. Continue down the test strip to the next square. Do one square at a time; record all observations. Dispose of the test strip.
7. Obtain another test strip. Repeat Steps 4 to 6 above, with specimen B; repeat Steps 4 to 6 with specimen C on a new test strip.
8. Compare the health of patients A, B, and C with Lab Sheet E-5D.
9. Use Lab Sheet E-5B for class discussion or homework.

### EVALUATION:

1. Completion of Lab Sheets E-5A and E-5B.

### RESOURCES:

1. Pinckney C and Pinckney E, Do-It-Yourself Medical Testing, Facts on File, NY, 1981.
2. Pflanzner R, Experimental and Applied Physiology, Brown Pub., Dubuque, IA, 1990.
3. biological supply companies (to purchase simulated urine and/or urine test strips).



NAME: \_\_\_\_\_

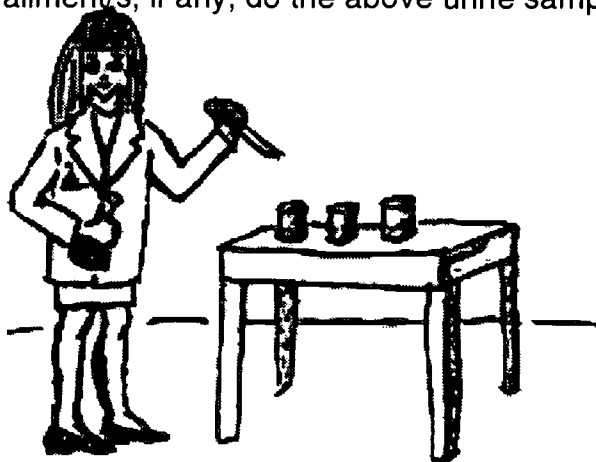
Lab Sheet E-5A Page1

# WHAT'S UP DOC?

Lab Observation Sheet

Urine Constituents	Patient A	Patient B	Patient C
Specific Gravity by a hydrometer			
Color of Urine			
Urine Test Strips leucocytes			
nitrite			
pH			
protein			
glucose			
ketone			
urobilinogen			
bilirubin			
blood/hemoglobin			

Using the attached "urinalysis report form," make conclusions for each patient based on the above observations. What ailment/s, if any, do the above urine samples display?



# WHAT'S UP DOC?

## Lab Observation Sheet

Urine Constituents	Patient A	Patient B	Patient C
<b>Specific Gravity</b> by a hydrometer	1.03	1.01	1.02
<b>Color of Urine</b>	straw yellow	bright yellow/orange	dark yellow
<b>Urine Test Strips</b> leukocytes	normal	normal	normal
nitrite	normal	normal	normal
pH	w7.0 (basic)	6.0	5.0 (acidic)
protein	+/30 (mod.high)	++/100 (high)	normal
glucose	normal	normal	1/2 (high)
ketone	++ (high)	normal	++ (high)
urobilinogen	normal	normal	normal
bilirubin	normal	normal	normal
blood/hemoglobin	50 (high)	normal	normal

Using the attached "urinalysis report form," make conclusions for each patient based on the above observations. What ailments, if any, do the above urine samples display? *Above answers may vary somewhat.*

- Dehydration/damage by severe exercise*
- Kidney Ailment*
- Diabetes Mellitus*

# WHAT'S UP DOC?

## Urinalysis Form

### Chemstrip® Urinalysis Report Form

Patient Name: \_\_\_\_\_

Age: \_\_\_\_\_ M \_\_\_\_\_ F \_\_\_\_\_

Physician's Name: \_\_\_\_\_

Collection Date: \_\_\_\_\_

Test Date: \_\_\_\_\_

Tester's Initials: \_\_\_\_\_

#### Physical Examination

Color: ☐ colorless

☐ yellow

☐ amber

☐ other

Appearance: ☐ clear

☐ hazy

☐ cloudy

☐ turbid

#### Chemical Examination (circle one)

specific gravity	1.000	1.005	1.010	1.015	1.020	1.025	1.030
leukocytes		neg	trace	+	++		
nitrite		neg	pos	(any pink color is considered positive)			
pH		5	6	7	8	9	
protein		neg	trace	+ / 30	++ / 100	+++ / 500 mg/dL	
glucose		normal	1 / 20	1 / 10	1 / 4	1 / 2	1 g/dL
ketones		neg	+small	++	+++		
urobilinogen		normal	1	4	8	12 mg/dL	
bilirubin		neg	+	++	+++		
blood		neg	5-10	50	250 ery/uL		
hemoglobin			10	50	250 ery/uL		

Comments: \_\_\_\_\_

NAME: \_\_\_\_\_

**WHAT'S UP DOC?**

Answer the following questions:

1. Why doesn't a test strip show results for all urine constituents?
2. Examine your chart "A Comparison of Urine Constituents" (E-5D). Under what conditions might a person have protein in their urine but not be ill with a disease?
3. If a person has diabetes and the urine does not show a positive sugar test, what is another way to diagnose the condition?
4. What appears to be the result of severe or excessive exercise?
5. How does one diagnose conditions of anorexia if it does not appear in the urine?
6. Why are those with a kidney ailment unable to have urine with a high specific gravity?
7. What are the indications for diabetes mellitus that can be found with a urinalysis?
8. For what conditions might ketones test positive in a urinalysis?

NAME: \_\_\_\_\_

## WHAT'S UP DOC?

### Answer Sheet

1. Why doesn't a test strip show results for all urine constituents?

*A test strip doesn't test all constituents because all constituents need not be tested every time. Also, excessive tests add to the overall cost.*

2. Examine your chart "A Comparison of Urine Constituents" (E-5C). Under what conditions might a person have protein in their urine but not be ill with a disease?

*Severe exercise damage, short term fasting, and dehydration.*

3. If a person has diabetes and the urine does not show a positive sugar test, what is another way to diagnose the condition?

*Blood sugar testing.*

4. What appears to be the result of severe or excessive exercise?

*Severe exercise can lead to urine with a high specific gravity, possible protein levels, and the possible presence of blood cells.*

5. How does one diagnose conditions of anorexia if it does not appear in the urine?

*Anorexia is extremely difficult to diagnose. Due to the homeostasis that is reached, many tests will show nothing abnormal.*

6. Why are those with a kidney ailment unable to have urine with a high specific gravity?

*Due to the high volume of urine that is output, minerals do not have time to build up in the urine and increase its specific gravity.*

7. What are the indications for diabetes mellitus that can be found with a urinalysis?

*Possible indication of Diabetes Mellitus are high volume of urine output, acidic pH, glucose is present, and ketones are present in uncontrolled cases.*

8. For what conditions might ketones test positive in a urinalysis?

*Ketones might test positive for Diabetes Mellitus, short term fasting, starvation, or dehydration.*

# WHAT'S UP DOC?

## A Comparison of Urine Conditions

Values for abnormal conditions

A few Urine constituents	Values for Normal condition (per day)	Diabetes mellitus	Liver ailments	Kidney ailments	Short term fast	Starvation (anorexia)	Infections (and fevers)	Severe exercise and dehydration
Volume	800-2,300 ml	above normal		above normal		may be above normal	below normal	below normal
pH	varies throughout the day 4.8-7.5	unvarying from acidic		unvarying from acidic			often cloudy	
color	straw yellow and darkens with increased specific gravity		darkened by bilirubin	may be yellow orange or turbid			often cloudy	
specific gravity	should change through the day 1.01 to 1.03			inability to read high	may be higher		usually high	generally high w/ dehydration
sugar (glucose)	"normal" is less than one gram	often present						
protein (albumin)	should read as "negative"			high levels	may appear		present with STD's, cold, severe cancers	some possible
ketones	should read as "negative"	appears in uncontrolled cases			higher than normal	some may appear		may appear w/ dehydration
blood cells and/or hemoglobin & myoglobin	no blood or hemoglobin is normal						occurs in anaerobic bacterial diseases	present in muscle injury & severe exercise
cells	some "skin" (epithelial) cells are normal			bacteria			leukocytes & bacterial cells	
urobilinogen & bilirubin	none is normal		urobilinogen bilirubin					
nitrite	none is normal						positive	

NAME \_\_\_\_\_

Lab Sheet E-5E

**WHAT'S UP DOC?****Urinalysis Testing Teacher Information**

The following is a list of the constituents which are detected by "Chemstrip 10" urine test strips. Please note, any urine strip which detects any or all of the tests below will suffice. In addition, an explanation is included to help you understand why each is tested.

1. **Specific Gravity** - (with a hydrometer) Measures ability of the kidneys to filter properly. Will vary throughout the day. Normally will be between 1.001 to 1.035.
2. **Leukocytes** - "White blood cells" should be negative. Indicates infection or inflammation.
3. **Nitrite** - A by-product of nitrate, which indicates that bacterial digestion has taken place; therefore, this should be negative. The presence of leukocytes and nitrites indicate the strong probability of a urinary tract infection.
4. **pH** - Healthy range approximately 5-6. Presence of infection will be detected with a pH of approximately 7-8.
5. **Protein** - Positive result indicates renal or kidney problems; therefore, test should be negative.
6. **Glucose** - Not normally found in urine. Positive test could indicate diabetes, hypertension, and/or obesity.
7. **Ketones** - A by-product of fat metabolism. A positive test result would mean a blood sugar imbalance, due to the metabolism of fat, dehydration, or over-exercising.
8. **Urobilinogen** - Indicates viral hepatitis, long term anemia, jaundice, and/or liver problems. Normal value will be less than 1.
9. **Bilirubin** - Not normal in urine. Could indicate liver problems like hepatitis.
10. **Blood** - Not normal in urine. Positive result indicates probable infection, kidney stones, diabetes, etc.

**\*\*A positive test result in the urine alone does not necessarily indicate a problem. Any positive result would need to be followed up with more extensive testing, (new urine sample, blood samples, etc.) by a physician or a clinical laboratory.**

NAME: \_\_\_\_\_

Lab Sheet E-5F Page 1

## SIMULATED URINE RECIPES: PREPARATION

You do not need distilled water to prepare simulated urine. Tap water will work just as well as distilled water. Depending upon the pH of your local water supply, the amounts of acid or base that you must add may vary from the formula. Rather than using the expensive urinalysis chemstrips to check pH of your simulated urine, use the less expensive standard pH test strips.

First begin by making a "Stock Solution" of "normal urine":

To 2000 ml (two liters) of water add one drop of yellow food coloring and one drop of red food coloring. (This should result in a "straw" color.) Next add approximately 60 grams (4 level tablespoons) of table salt (NaCl). (This should give solution a specific gravity close to 1.017; however, any value between 1.010 and 1.024 would be good at this point.)

Next add approximately 10 drops of concentrated hydrochloric acid (HCl) to bring the pH down to 6. If you do not have concentrated HCl, then you can add a weaker form of HCl until the pH reaches 6. (See "Simulated Condition A" below before adding the acid; you may wish to postpone adding the acid if you are going to use condition "A.")

### Simulated Condition A (severe exercise damage or dehydration)

To 1000 ml of the stock solution add:

- 5+ drops of interstitial fluid from packaged meat (turkey, chicken, pork, or beef). You can take the absorbent blotter under the meat and use it like a "tea bag" to release enough blood cells.
- 30 grams of table salt (NaCl)
- 1 ml of acetone (which is a ketone) ... this ingredient is optional
- bring the pH close to 7 or 8 by adding ammonia

### Simulated Condition B (kidney ailment)

To 1000 ml of the stock solution add:

- 1 ml of egg white (albumin). For convenience, we have discovered that one squirt from an eyedropper is nearly equivalent to one milliliter.
- 2 drops of yellow food coloring



Simulated Condition C (diabetes mellitus)

To 300 ml of the stock solution add:

- a. 700 ml of water
- b. 6+ ml of glucose (corn syrup)
- c. 1 or 2 ml of acetone (which is a ketone)
- d. bring the pH closer to 5 or 6 by adding HCl

As a side note to urinalysis: Doctors often look for “nitrates” in the urine as an indicator of infection; this is because nitrates are a by-product of bacterial action. The bacterial cells do not have to appear in the urine to indicate infection. Since we are using urinalysis strips which do not indicate nitrates, there may be some confusion in the interpretation of Simulated Condition A. Once again, look at the chart entitled “A Comparison of Urine Conditions.” Note what the conditions of “infection” have in common with “severe exercise”: specific gravity and the presence of blood cells. In using a urinalysis strip with only 6 indicators, the only way we could make a distinction between “infection” and “severe exercise” would be through pH. The pH for “infections” would usually be acidic (pH 4 to 5) whereas we have purposely made the pH neutral or even alkaline (pH 7 to 8).

## LESSON SIX: "Fit as a Fiddle"

Note to Teacher: It is important here, as always, to be sensitive to students with special physical needs and to stress to all students that the goal of this lesson is not to be the best in the class but to assess and improve his or her own physical/athletic condition. This lesson could be taught with the student's physical education teacher, if he or she is willing. Some schools already use the physical fitness tests listed below every year with their students. If that is the case at your school, this lesson could be taught at that time. The prevention of osteoporosis is just one benefit of getting regular exercise. Please read Teacher Information Sheet E-6D to prepare for this lesson.

**TIME:** two 45-minute classes



**OBJECTIVES:** The Student will:

1. Explain the role of exercise in preventing osteoporosis;
2. Assess personal physical fitness according to basic good health standards; and
3. Set goals for personal improvement in his/her physical condition.

**VOCABULARY:**

weight bearing exercise: an exercise that causes muscles to work against the force of gravity, such as stair climbing, running, or tennis.

**MATERIALS AND EQUIPMENT:**

Lab Sheets E-6A, E-6B, E-6C

stopwatch or a watch with a second hand

step or box for sit and reach exercise (see Teacher Information Sheet E-6D)

pull-up bar

mat or other area for sit-ups

track or measured distance to run/walk one mile

**PREPARATION:**

1. Read Teacher Information Sheet E-6D and prepare necessary materials for lesson.
2. Locate an area where tests can be performed; if your school has a track, arrange to use it for your class.
3. Duplicate Lab Sheets E-6A, E-6B, and E-6C, one each per student.
4. Prepare students ahead of time for this lesson, so they can have appropriate clothing.

**PROCEDURE:**

1. Discuss with students the effects of regular exercise on health in general, and in osteoporosis prevention in particular.
2. Distribute Lab Sheet E-6A and prepare students for the physical fitness test.
3. Perform activities in the fitness test. Students should be in pairs for most activities, and should receive supervision in all activities. The 1-mile run will need a person to watch the timer and record the individual times of the students.
4. After the activities are complete, distribute Lab Sheet E-6B. Students will compare their performances with the minimum standards on the charts. Discuss ways to improve their

- performances in the future, and encourage them to set goals.
5. Distribute Lab Sheet E-6C. Students should answer questions about exercise, and discuss either in small groups or as a class. Encourage students to come up with a wide-ranging list of activities or games that will give them exercise. Many students may not realize how fun exercise can be.

**EVALUATION:**

1. Participation in fitness test.
2. Completion of Lab Sheet E-6C.

**RESOURCES:**

1. Cooper K, Kid Fitness, Bantam Books, NY, 1991.
2. exercise physiologist, sports trainer, gym teachers.
3. National Osteoporosis Foundation, Boning Up on Osteoporosis, and other consumer literature. Call 1-800-223-9994.

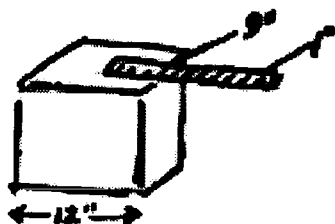
Name: \_\_\_\_\_

With the help of your teacher, you will perform a few physical activities so that you can judge how fit you are. Follow the directions for each activity and see if you meet the standards for good basic physical health, according to the Institute for Aerobics Research.

**Fitness Test #1: The 1-Mile Run/Walk.** This is a test of aerobic fitness--your level of endurance. It is important to pace yourself as you run a mile--don't start out at your highest speed or you will tire very early! Your teacher or another student will time you with a stopwatch as you run or walk. For best achievement, you should keep your head and chest up and allow your bent arms to swing alongside your body or across your chest. Your whole foot or heel should hit the ground first--don't run on your toes only. The shoes you wear are important--if you have running shoes or good tennis shoes, wear those.

**Fitness Test #2: Sit and Reach.** This activity will test the flexibility of your lower back and the muscles on the backs of your thighs. Your teacher has set up a place to test your reach. Here are the steps to follow:

1. Take off your shoes.
2. Take some practice stretches by slowly touching your toes, either while sitting or standing.
3. Sit at the base of the box or stair, with legs straight and feet shoulder width apart. Your feet should be flat against the front of the stair or box, with backs of heels on the floor. (See illustration.)
4. Place your hands on top of each other and put them out in front of you, in a comfortable position toward the ruler.
5. A partner should place his or her hands on your knees to keep them from bending.
6. Reach forward slowly with both hands along the measuring scale three times, and each time return to the starting position.
7. Reach forward slowly with both hands a fourth time and for at least one second hold a position at the farthest spot you can touch on the ruler. Do not bounce forward, because bouncing doesn't measure true flexibility.
8. Your score is the number you touched on the ruler on your fourth try, calculated to the nearest half inch. Higher scores mean higher flexibility.



**Fitness Test #3: Sit-Ups.** Everyone has probably tried to do some sit-ups. For this activity you will need a partner. It is important to do your sit-ups the way the directions tell you--otherwise you may hurt your neck or back. This test will measure the strength in your abdomen.

1. Lie on a mat or comfortable surface. The bottoms of your feet should be flat on the floor and your knees should be bent. There should be about 15 inches between your heels and the rest of your body.
2. Cross your arms and place them across your chest. Grasp opposite shoulders with your hands.
3. Your partner should hold your feet flat on the mat.
4. Tuck your chin into your chest and curl up to a sitting position. When your elbows touch your thighs, you have done one sit-up.
5. Your partner will use a stopwatch and tell you when to start. He or she will count how many sit-ups you can do in one minute.

**Fitness Test #4: Pull-Up or Flexed Arm Hang.** These activities test the strength in your upper body. Choose the pull-up or the flexed arm hang. To do a pull-up:

1. Hang from the pull-up bar with palms facing away from you. Make sure your feet do not touch the floor, and don't let your body swing. If the bar is not dry, make sure you wipe it off.
2. In a smooth movement, pull your body upward until your chin is above the bar. Return to the full hanging position with arms straight. No swinging or kicking allowed!
3. Do as many pull-ups as possible without dropping to the ground, but you can hang and rest if you want to.

If you cannot do a pull-up, the flexed arm hang will also test your upper body strength. To do the arm hang:

1. Grasp the pull-up bar with palms facing away from you.
2. With the help of a friend, or by jumping, or stepping from a chair, raise your body off the floor so that your chin is above the bar with arms bent. Your feet should not touch the floor, and your body should hold still. You want to hang from the bar, with your chin still above and not resting on the bar, for as long as possible.
3. A partner should begin timing you as soon as you are in place, with your chin above the bar. If your head tilts backward or your chin falls to or below the bar, the clock should be stopped.
4. Your score is the number of seconds you can hold your chin above the bar.

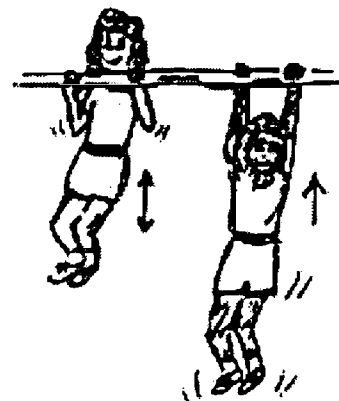
**Record your scores here:**

1-Mile Run/Walk (minutes:seconds) \_\_\_\_\_

Sit and Reach (inches) \_\_\_\_\_

Sit-Ups \_\_\_\_\_

Pull-Ups or Flexed Arm Hang \_\_\_\_\_



Name: \_\_\_\_\_

Lab Sheet E-6B

Are you healthy? According to the Institute for Aerobics Research, these scores are the minimum for basic good health.

### Health-Related Fitness Test Standards for Girls

#### Test Items

AGE	1-MILE RUN/WALK (mins:secs)	SIT AND REACH (inches)	SIT-UPS	PULL-UPS	FLEXED ARM HANG (seconds)
8	14:00	10.0	25	1	8
9	13:00	10.0	25	1	8
10	12:00	10.0	30	1	8
11	12:00	10.0	30	1	8
12	12:00	10.0	30	1	8
13	11:30	10.0	30	1	12
14	10:30	10.0	35	1	12
15	10:30	10.0	35	1	12
16	10:30	10.0	35	1	12
16+	10:30	10.0	35	1	12

### Health-Related Fitness Test Standards for Boys

#### Test Items

AGE	1-MILE RUN/WALK (mins:secs)	SIT AND REACH (inches)	SIT-UPS	PULL-UPS	FLEXED ARM HANG (seconds)
8	13:00	10.0	25	1	10
9	12:00	10.0	25	1	10
10	11:00	10.0	30	1	10
11	11:00	10.0	30	1	10
12	10:00	10.0	35	1	10
13	9:30	10.0	35	2	10
14	8:30	10.0	40	3	15
15	8:30	10.0	40	5	25
16	8:30	10.0	40	5	25
16+	8:30	10.0	40	5	25

Name: \_\_\_\_\_

We hear all the time on television that it is important to get regular exercise and to be in tip-top shape--we hear that it is good for hearts, bodies, and minds. We know now that it is actually good for keeping our bones strong, and not just for making our muscles bigger. The stronger our bones are, the less chance there is that we will develop osteoporosis in later life. With osteoporosis, bones actually lose tissue and can break more often. Because our bones are living things, they will grow stronger with exercise. But having strong bones is just one benefit of regular exercise.

There are other ways than organized sports or a regular exercise program to get in shape. List ways that people get exercise.

Do you get any exercise? A lot of exercise? What are the things you do that count as exercise?

How physically fit do you think you are? How can you judge how fit you are?

Are you satisfied with your level of physical fitness? If not, how could you improve your physical condition?

What do you think you personally would gain from being in great physical shape?

# TEACHER INFORMATION SHEET

Bone is living tissue that responds to exercise by becoming stronger. Men and women who exercise regularly have a higher peak bone mass (maximum bone strength and density) than those who do not. Weight-bearing exercise, such as walking, hiking, stair climbing or jogging is recommended over non-weight bearing exercise such as swimming or cycling. However, any exercise is better than none at all. Regular exercise may increase peak bone mass for younger people and decrease bone loss or even increase bone mass in older women and men. Osteoporosis (disease caused by bone tissue loss) and the resulting painful fractures will be much less likely in people whose bones are made healthy by both exercise and proper nutrition.

The general benefits from regular exercise are well-known: improved muscle tone(strength) and endurance, better circulation, heightened sense of well-being, lower resting heart rate, and better pulse recovery rate after exercise. It is easier to begin exercising as a young person than as an adult. Adolescence is a time when many students lose their interest in physical activity. It is in the early teens that competition, rather than the joy of playing, becomes the most important factor in team sports. Those children who do not have the best athletic skills become discouraged in the face of constant pressure from some parents and coaches, and often drop out of organized teams altogether. Their activities then become more sedentary, which makes it difficult to stay in good physical condition.

The Institute for Aerobics Research, which developed the fitness test in this lesson, has found that girls start out well in meeting fitness standards: at age 7, 86 percent of girls can pass a basic 1-mile run test, and 57 percent can pass an upper-body strength test. By age 15, however, only 49 percent of girls can pass the 1-mile run test, and 27 percent pass the upper-body strength test. Boys also see a drop in performance: 76 percent of 7-year-old boys pass the 1-mile run test and 62 percent pass the upper-body strength test. At age 15, only 60 percent pass the 1-mile run test, and 50 percent the upper-body strength test. If these children continue to decline in physical fitness, they will be at greater risk for a variety of health problems in later life, including osteoporosis.

## Instructions for Sit and Reach Test Materials:

For this test, students need an apparatus that will test their flexibility. Teachers can use either:

1. A stair step: Tape a ruler (at least 12 inches long) to the stair so that the 9-inch mark is exactly in line with the vertical plane of the stair. The lower numbers on the ruler should hang over the edge of the stair. Students will place their feet flat against the front of the stair and reach towards the ruler with their arms.
2. A sturdy cardboard box (or any other appropriate rectangular object) at least 12 inches tall. Use the box as you would the stair in #1. Tape the ruler to the box at the 9-inch line, and place the box where it will not move when students place their feet against it.



## RESOURCES FOR MODULE 4: EXERCISE PHYSIOLOGY

American Heart Association: General Public Videos: 1-800-282-0291.

Circulatory & Respiratory Systems 17 minutes

I Am Joe's Heart: New Version 25 minutes

Kids At Heart 10 minutes

biological supply companies (to purchase simulated urine and/or urine test strips).

Cooper K, Kid Fitness, Bantam Books, NY, 1991.

exercise physiologist from local educational institution (sports trainer) or sports medicine facility, trained health professional.

Hotline 1-800-STEROID for questions about steroids.

National Osteoporosis Foundation, Boning Up on Osteoporosis, 1991, 1-800-223-9994.

### Other Resources:

American College of Sports Medicine, P.O. Box 1440, Indianapolis, IN 46206.  
(317) 637-9200

Kuntzleman C, Healthy Kids for Life, Simon & Schuster, NY, 1988. ISBN 0-671-60742-1.

National Clearinghouse for Alcohol and Drug Information, P.O. Box 2345, Rockville, MD 20852.

National Institute on Drug Abuse, 5600 Fishers Lane, Rockville, MD 20857. 1-800-662-HELP

Ohio Health Promotion Network, Bureau of Health Promotion and Education, Ohio Department of Health, P.O. Box 118, Columbus, OH 43266-0118. (614) 644-7852. Various educational materials.

Parker S, The Skeleton and Movement, Franklin Watts Pub., NY, 1989.  
ISBN 0-5312-4606-X.

Pinckney C and Pinckney E, Do-It-Yourself Medical Testing, Facts on File, NY, 1989. ISBN 0-8160-1928-2.

Pflanzer R, Experimental and Applied Physiology, Brown Pub., Dubuque, IA, 1990. ISBN 0-697-01177-1.

Regents of the Univ. of California, "Jog-Walk," Health Activities Project, 1976.

Simon N, Good Sports: Plain Talk About Health & Fitness for Teens, Thomas Crowell, NY, 1990. ISBN 0-690-04902-1.

## MODULE 5: GENETICS

Genetics is the study of how characteristics are transmitted from one generation to another.

In this module the Student will:

Lesson One:

- (a) Demonstrate the concept of dominant and recessive traits through the formation of Punnett Squares.

Lesson Two:

- (b) Define basic terminology necessary to understand genetics.
- (c) Make observations, record data, and compare various inherited traits among small groups, the class, and all classes.
- (d) Form into various gene pools based on the data that is gathered.
- (e) Predict and record potential offspring traits that could be inherited.

Lesson Three:

- (f) Demonstrate an understanding of dominant and recessive traits by determining the potential offspring traits that could be inherited from a predetermined set of parent traits.

Lesson Four:

- (g) Make metacarpal measurements in order to compute cortical thickness of parents and offspring.
- (h) Construct scattergrams from the recorded data on cortical thickness to determine potential correlations.

Lesson Five:

- (i) Measure, plot, compare, and contrast height measurements with national norms and parent history.

Lesson Six:

- (j) Discuss genetic diseases and disorders with his/her "family" and research specific information regarding environmental components that could influence the disorder.

## LESSON ONE: "Punnett Square"

Note to Teacher: This can be a very sensitive subject area, particularly because a significant number of families include either an adopted child, foster child, interracial child, or a child from a divorced/separated parent. We have developed this lesson to include a set of data for Grandpa and Grandma Smith, a family, so that students who cannot obtain accurate birth family data can complete the exercises. You may wish to send home a letter to the parents.

**TIME:** one 45-minute class



**OBJECTIVES:** The Student will:

1. Demonstrate the concept of dominant and recessive traits through the calculation of Punnett Squares.

### VOCABULARY:

characteristics: the unique or distinct traits that comprise an object or person

DNA: the genetic material in cells

dominant: when present, a trait that appears in offspring; expressed with an uppercase letter in a Punnett Square

gene: a portion of the genetic material that carries hereditary traits

genetics: the study of heredity; how traits are passed from one generation to another

Punnett Square: a way of determining potential genetic traits in offspring

recessive: when present, a trait that is masked unless it is pure (expressed by both parents); expressed in a lowercase letter in a Punnett Square

### MATERIALS:

Lab Sheets G-1A through G-1E

### PREPARATION:

1. Read Explanation Sheet G-1C.
2. Duplicate Lab Sheets G-1A, G-1B, and G-1D, one each per student.

### PROCEDURE:

1. Introduce lesson by discussing Lab Sheet G-1A.
2. Complete G-1A.
3. Lead into G-1B by explaining about dominant and recessive genes, using tongue rolling as an example.
4. Complete Lab Sheet G-1D.

### EVALUATION:

1. Completion of Lab Sheets G-1A and G-1D.

### RESOURCES:

1. Gutnik M, Genetics: Projects for Young Scientists, Franklin Watts Pub., NY, 1985.
2. "Who Are You?" AAY4337. 1995 Films for the Humanities and Sciences. P.O. Box 2053 Princeton, NJ, 08543. 1-800-257-5126. Fax # 609-275-1400.

NAME: \_\_\_\_\_

Lab Sheet G-1A

# PUNNETT SQUARE

Who Do I Favor?

Describe the ways you are like your mother, father, or any other relative. Use the back if necessary.

**Physical Traits** : (facial features, size & shape of feet, birth marks, etc.)

Mother
Father
Other Relative  
(specify)

**Personality Traits**: (temperament, shyness, sense of humor, etc.)

Mother
Father
Other Relative  
(specify)

**Interests**: (hobbies, food preference, participation in sports, etc.)

Mother
Father
Other Relative  
(specify)

Which of the above items are learned and/or affected by the environment?

NAME: \_\_\_\_\_

# PUNNETT SQUARE

Genetic Characteristics

## Dominant

## Recessive

- |  |                             |
|--|-----------------------------|
| 1. Widow's peak (W)                              | No peak (w)                 |
| 2. Dark hair/non red (B)                         | Blonde or red (b)           |
| 3. Naturally curly hair (C)                      | Straight hair (c)           |
| 4. Mid digital hair (H)                          | No mid digital hair (h)     |
| 5. Ear lobes free (F)                            | Attached lobes (f)          |
| 6. Darwin's ear point (P)                        | No point (p)                |
| 7. Dimples (D)                                   | No dimples (d)              |
| 8. Left thumb on top of interlocking fingers (L) | Right thumb on top (l)      |
| 9. Hyperextended "hitchhiker's" thumb (J)        | No "hitchhiker's" thumb (j) |
| 10. Tongue rolling (T)                           | Inability to roll (t)       |



NAME: \_\_\_\_\_

## PUNNETT SQUARE EXPLANATION

A Punnett Square is simply a way to determine the potential offspring that can be produced during any given cross. When setting up a Punnett Square, the gene expression for the male is normally written across the top, while the gene expression for the female is written down the left side.

In the cross of a pure tongue rolling male and a non-tongue rolling female (TT x tt), the Punnett Square would be set up as follows:

		(male gene)	
		T	T
(female gene)	t	Tt	Tt
	t	Tt	Tt

The offspring combinations are represented by the four smaller squares. The squares are filled in by taking one letter from each parent, with the upper case letter written first. Both letters together represent one probable gene expression.

In this example all the offspring will be tongue rollers since all possess the dominant trait (T). The ratio for probable gene combinations is 4 to 4 or 100%, since all have the expression (Tt).

Below is the Punnett Square for the cross of two hybrid tongue rollers. They both can roll their tongues, but each is a carrier of the recessive trait (t) for this gene.

		T	t
	T	TT	Tt
	t	Tt	tt

In this example, the ratio for how all of the offspring will appear is 3/4. In other words, 75% will be tongue rollers while 1/4 or 25% will not be able to roll their tongues. In addition, the ratio for probable gene combinations is 1 TT or 25%, 2 Tt or 50%, and 1 tt or 25%.

NAME: \_\_\_\_\_

## PUNNETT SQUARES

Meet the Smith family. "Grandpa" George Smith, age 67, has a widow's peak (WW), can roll his tongue (TT), and has no dimples (dd). "Grandma" Martha Smith, age 62, has no widow's peak (ww), can roll her tongue (TT), and has dimples(DD).

**Part 1:** Use the Punnett Squares to determine the probability that their son, Bill, age 30, will have the following traits:

1. Will he have a widow's peak? \_\_\_\_\_
2. Can he roll his tongue? \_\_\_\_\_
3. What are his chances of having or not having dimples? \_\_\_\_\_

Bill's wife, Mary, has a widow's peak (Ww), cannot roll her tongue (tt), and has no dimples (dd). They are expecting the birth of their first child.

**Part II:** On scrap paper or the back, make your own Punnett Squares. What are the chances that the baby:

Is a boy? (Use XY) \_\_\_\_\_  
 Has a widow's peak \_\_\_\_\_  
 Can roll the tongue \_\_\_\_\_  
 Has dimples \_\_\_\_\_

Is a girl? (use XX) \_\_\_\_\_  
 No widow's peak \_\_\_\_\_  
 Inability to roll \_\_\_\_\_  
 Has no dimples \_\_\_\_\_

NAME: \_\_\_\_\_

Lab Sheet G-1E

# PUNNETT SQUARES

## Answer Key

Meet the Smith family. "Grandpa" George Smith, age 67, has a widow's peak (WW), can roll his tongue (TT), and has no dimples (dd). "Grandma" Martha Smith, age 62, has no widow's peak (ww), can roll her tongue (TT), and has dimples (DD).

**Part 1:** Use the Punnett Squares to determine the probability that their son, Bill, age 30, will have the following traits: On each line give the ratio (or numbers) for how all the offspring will appear as well as for the probable gene combinations.

1. Will he have a widow's peak? Yes

		W	W	Grandpa
	w	Ww	Ww	
Grandma	w	Ww	Ww	

2. Can he roll his tongue? Yes

		T	T	Grandpa
	T	TT	TT	
Grandma	T	TT	TT	

3. What are his chances of having 100% or not having dimples? 0%

		d	d	Grandpa
	D	Dd	Dd	
Grandma	D	Dd	Dd	

Bill's wife, Mary, has a widow's peak (Ww), cannot roll her tongue, and has no dimples. They are expecting the birth of their first child.

**Part II:** On scrap paper or the back, make your own Punnett squares to determine the ratios of their child in having any of the following traits:

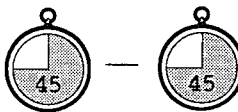
Is a boy? (Use XY) 50%  
 Has a widow's peak 75%  
 Can roll the tongue 100%  
 Has dimples 50%

Is a girl? (use XX) 50%  
 No widow's peak 25%  
 Inability to roll 0%  
 Has no dimples 50%



## LESSON TWO: "The Gene Pool" (may be taught before Lesson One)

**TIME:** one to two 45-minute classes



**OBJECTIVES:** The Student will:

1. Be able to define basic terms necessary to comprehend genetics;
2. Observe, record, and compare hereditary traits of self and group members;
3. Form various gene pools from gathered data; and
4. Predict and list possible offspring traits from the gene pool of a small group.

### VOCABULARY:

characteristics: the unique or distinct traits that comprise an object or person

DNA: the genetic material in cells

dominant: when present, a trait that appears in offspring; expressed with an uppercase letter in a Punnett Square

gene: a portion of the genetic material that carries hereditary traits

gene pool: the total of all genes in a given population

genetics: the study of heredity; how traits are passed from one generation to another

Punnett Square: a way of determining potential genetic traits in offspring

recessive: when present, a trait that is masked unless it is pure (expressed by both parents); expressed in a lowercase letter in a Punnett Square

### MATERIALS AND EQUIPMENT:

Lab Sheets G-2A through G-2D

### PREPARATION:

1. Duplicate all Lab Sheets, one each per student.
2. Make overhead transparency of G-2C.

### PROCEDURE:

1. Distribute all lab sheets to students.
2. Divide the class into groups of four or less.
3. Each student will check their individual genetic characteristics on Lab Sheet G-2A. Each student records the number of students possessing that same characteristic within each group.
4. Using the data from Step 3, instruct each small group to determine and record their dominant and recessive traits.
5. Compile and display group totals to determine class totals for each characteristic.
6. Have students determine the dominant and recessive traits for the entire class.
7. Using Lab Sheet G-2C, call out characteristics as students move around the room into appropriate groups. e.g. "All males to the right side of the room. All females to the left side." Have students record totals as they move.
8. Record gene pool data from Lab Sheet G-2C, and display on overhead.
9. Have students determine dominant traits based on classroom data.
10. During the next class, share all classroom data with each class to demonstrate how certain traits are affected by the size and variation of the gene pool.

Optional:

11. Complete Lab Sheet G-2D. Follow procedure for Lab Sheet G-2A.

**EVALUATION:**

1. Completion of Lab Sheets G-2A and G-2C.

Optional:

2. Survey of school or grade level on Lab Sheet G-2B and graph of results.
3. Completion of Lab Sheet G-2D.

**RESOURCES:**

1. Gutnik M, Genetics: Projects for Young Scientists, Franklin Watts Pub., NY, 1985.

NAME: \_\_\_\_\_

# GENE POOL

Genetic Characteristics

See if you exhibit any of the traits listed below. Then using the recorded data, determine the dominant and recessive traits for your small group and for the entire class.

Class Total		Characteristics	Yes	No
		1. Widow's peak		
		2. Dark hair/non red		
		3. Naturally curly or wavy hair		
		4. Mid digital hair		
		5. Ear lobes free		
		6. Darwin's earpoint		
		7. Dimples		
		8. Left thumb on top of interlocking fingers		
		9. Hyperextended "hitch-hiker's" thumb		
		10. Tongue rolling		

NAME: \_\_\_\_\_

Lab Sheet G-2B

# PUNNETT SQUARE

Genetic Characteristics

Dominant
Recessive

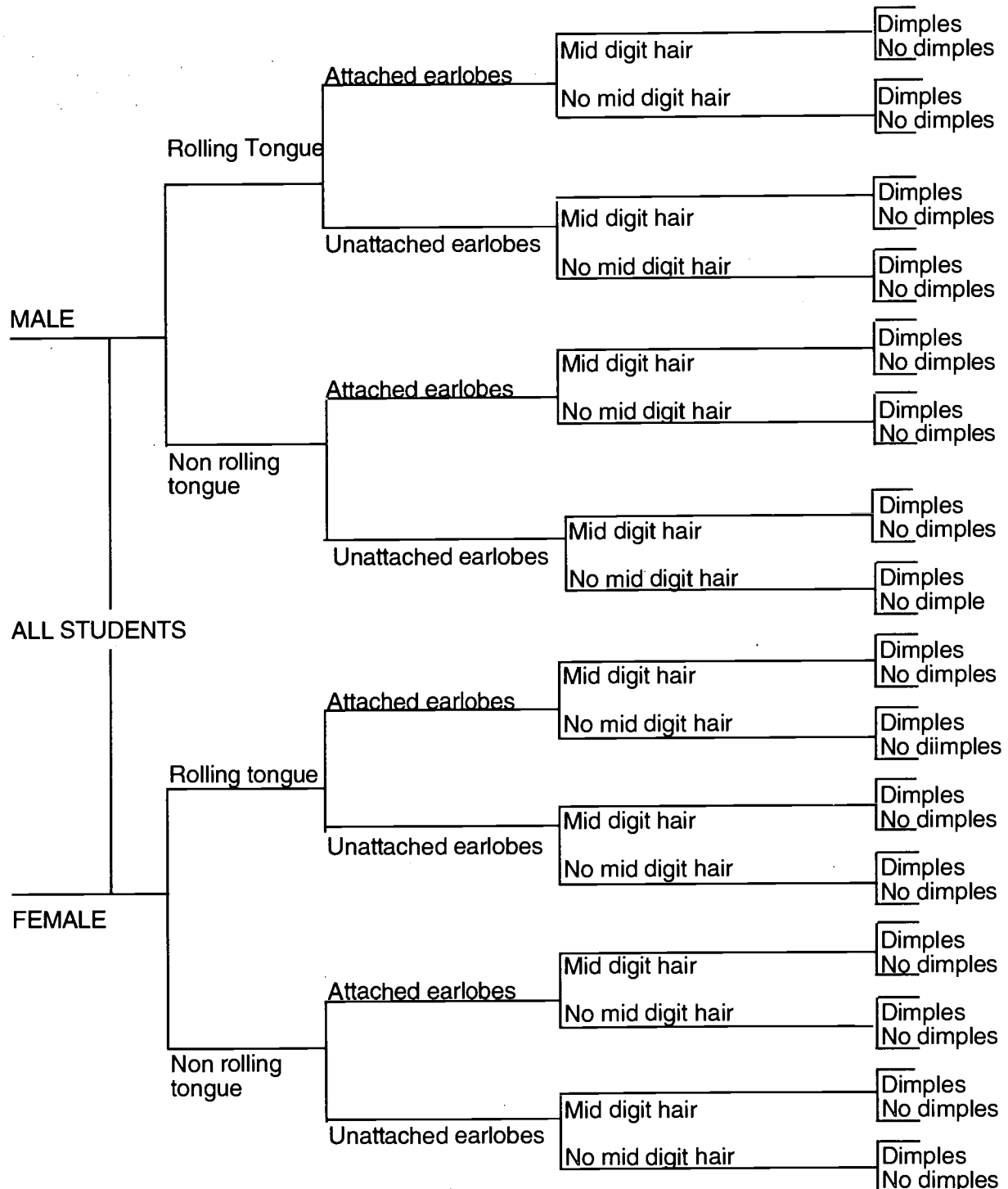
- |  |                             |
|--|-----------------------------|
| 1. Widow's peak (W)                              | No peak (w)                 |
| 2. Dark hair/non red (B)                         | Blonde or red (b)           |
| 3. Naturally curly hair (C)                      | Straight hair (c)           |
| 4. Mid digital hair (H)                          | No mid digital hair (h)     |
| 5. Ear lobes free (F)                            | Attached lobes (f)          |
| 6. Darwin's ear point (P)                        | No point (p)                |
| 7. Dimples (D)                                   | No dimples (d)              |
| 8. Left thumb on top of interlocking fingers (L) | Right thumb on top (l)      |
| 9. Hyperextended "hitchhiker's" thumb (J)        | No "hitchhiker's" thumb (j) |
| 10. Tongue rolling (T)                           | Inability to roll (t)       |

NAME: \_\_\_\_\_

Lab Sheet G-2C

# “GENE POOL” CHART

Summary of Class Characteristics  
Class Section



NAME: \_\_\_\_\_

Lab Sheet G-2D

# “GENE POOL ENRICHMENT”

## Human Genetic Traits

DOMINANT:

RECESSIVE:

I AM:

F	Black skin	B	White skin
G	Freckles	F	No freckles
H	Iris pigmented: brown, hazel, green	B	Iris lacks pigment: blue/grey
I	Color vision normal	N	Color blindness
J	Nearsighted, farsighted astigmatism	F	Normal vision
M	Broad lips	L	Thin lips
O	Long eyelashes	E	Short eyelashes
P	High, narrow bridge of nose	N	Low, broad bridge of nose
S	Last segment of little finger bent when viewing palms (campylodactyl)	F	Straight last segments
T	Polydactyl (6+ digits) Syndactyl (webbed fingers & toes)	H	Normal hand: 5 digits, no webbing
V	Normal blood clotting	B	Hemophilia (bleeder)
W	Blood types: A, B, or AB	T	Blood type O
X	Normal blood sugar	S	Diabetes mellitus
Z	Migraine headaches	M	Normal

## LESSON THREE: "The Family Album"

**TIME:** One 45-minute class



**OBJECTIVE:** The Student will:

1. Demonstrate an understanding of dominant and recessive traits by determining the potential offspring traits that could be inherited from a predetermined set of parent traits.

### VOCABULARY:

characteristics: the unique or distinct traits that comprise an object or person

gene: a portion of the genetic material that carries hereditary traits

dominant: when present, a trait that appears in offspring; expressed with an upper case letter

recessive: when present, a trait that is masked unless it is pure (expressed by both parents); expressed with a lower case letter

### MATERIALS:

Lab Sheets G-3A, G-3B and G-3C

Multicultural crayons or markers

### PREPARATION:

1. Code and color parent cards (3-4 mother and father cards) found in Lab Sheet G-3C.
2. Using all possible parent combinations, color children cards according to potential offspring traits. Make sure there are at least four children for each parent combination.  
For example:

	<u>Father</u>	<u>Mother</u>
SKIN COLOR	Ss	ss
HAIR COLOR	Hh	Hh
EAR LOBES	FF	ff
HAIR TYPE	cc	Cc
EYE COLOR	li	ii

### POSSIBLE CHILDREN

Dark skin	Dark skin
Dark hair	Dark hair
Free ear lobes	Free ear lobes
Curly hair	Straight hair
Brown eyes	Brown eyes

Light skin	Light skin
Blonde hair	Dark hair
Free ear lobes	Free ear lobes
Straight hair	Straight hair
Blue eyes	Blue eyes

**PROCEDURE:**

1. Students should already be familiar with the concept of dominant and recessive genes.
2. Game can be played with 2-3 players.
3. Each player needs a Family Album worksheet and Traits Key( Lab Sheet G-3A and G-3B).
4. Each player randomly chooses a mother and father card.
5. Using these cards, each player should color and code the top two boxes on their Family Album worksheet.
6. When all players have finished coloring and coding, the game is ready to begin.
7. All of the children cards are spread out on the table, face down.
8. The first player chooses a card. If that child card shows the traits that are a potential combination, based on the player's parent cards, that player may color one of the bottom boxes on their worksheet to match this child card. If this child card does not show the potential traits, the card is returned to the pile.
9. Play continues with the next player.
10. When one player has completed all of the bottom boxes, s/he is the winner. Play should continue until everyone has completed their worksheet.

**EVALUATION:**

1. Completion with accuracy of the Family Album worksheet.

**RESOURCES:**

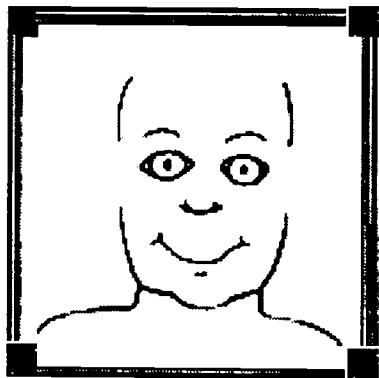
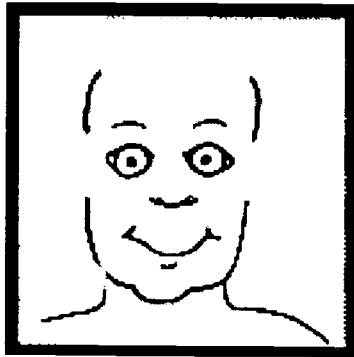
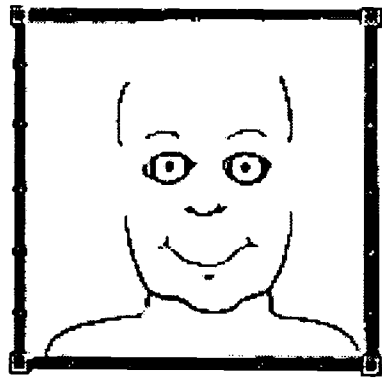
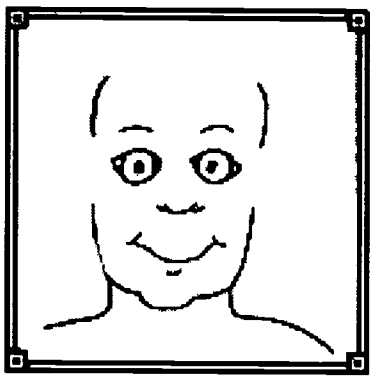
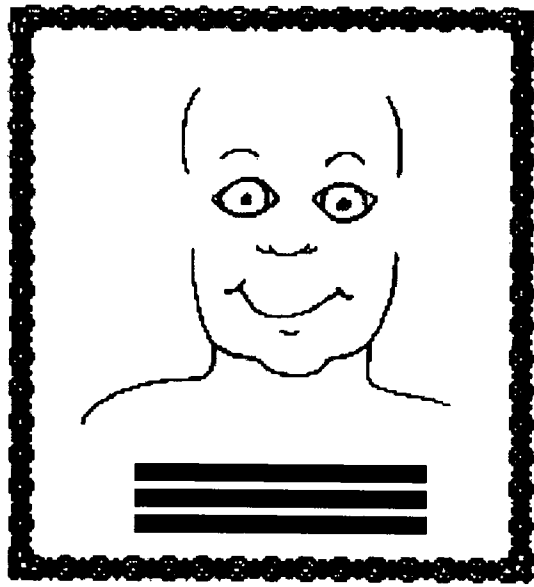
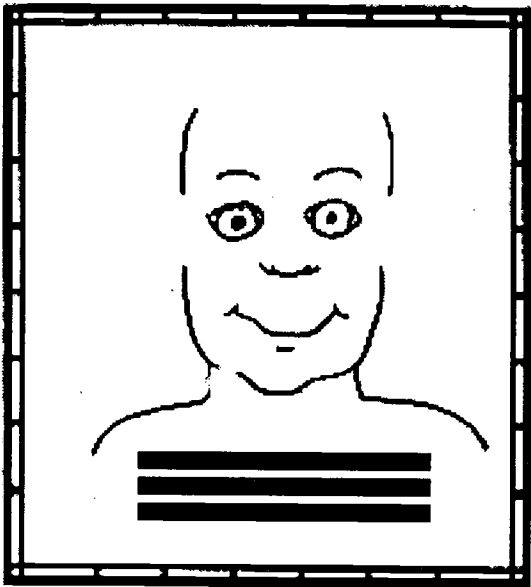
1. Gutnik M, Genetics: Projects for Young Scientists, Franklin Watts Pub., NY, 1985.
2. "Who Are You?" AAY4337. 1995 Films for the Humanities and Sciences.  
P.O. Box 2053, Princeton, NJ, 08543. 1-800-257-5126. Fax # 609-275-1400.

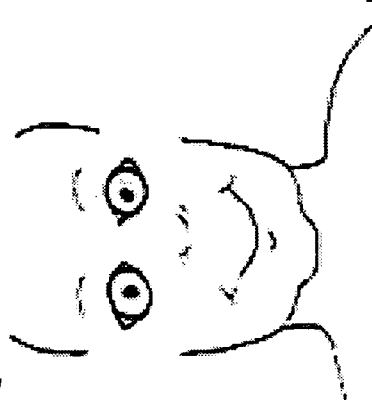
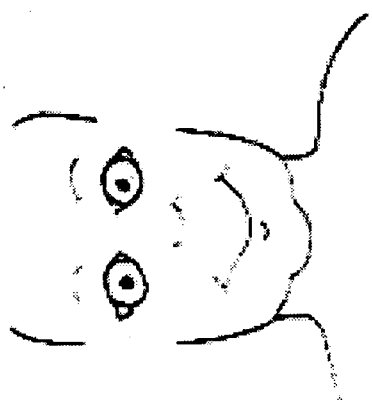
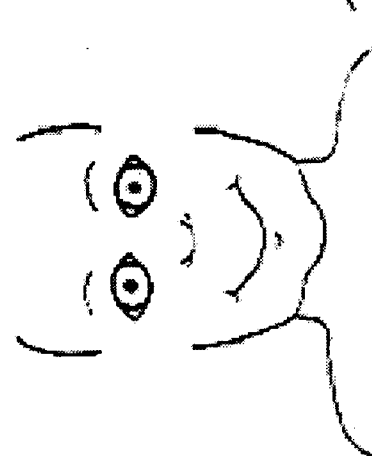
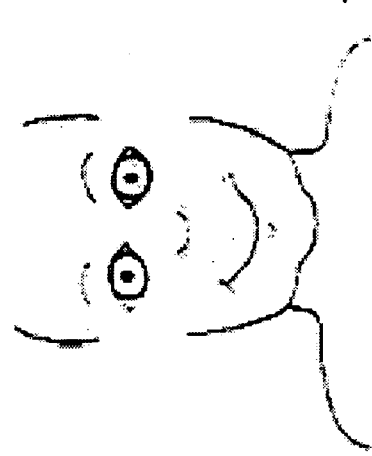
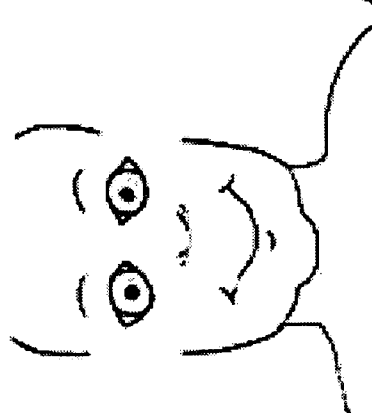
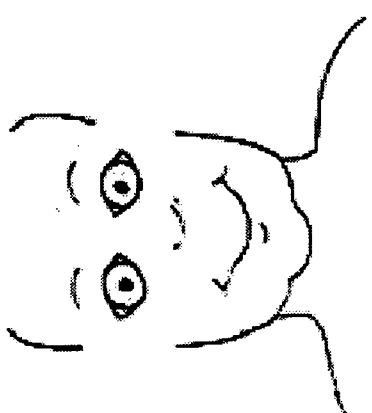
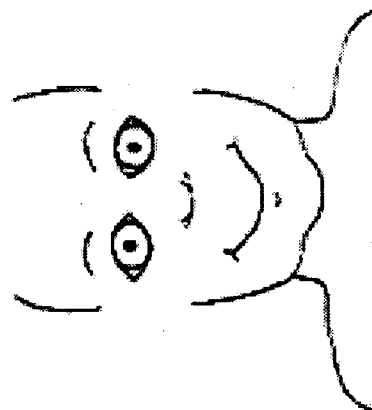
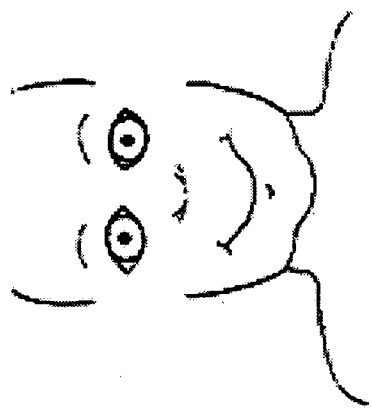


# Traits Key

TRAIT	DOMINANT	RECESSIVE
Skin color	Dark -- S	Light -- s
Hair color	Dark -- H	Blonde-Red -- h
Ear lobes	Free -- F	Attached -- f
Hair Type	Curly -- C	Straight -- c
Eye Color	Iris -- I brown hazel green	Iris -- i blue gray

# FAMILY ALBUM





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## LESSON FOUR: "X-Ray Vision"

**TIME:** one 45-minute class



**Note to Teacher:** This lesson demonstrates the physical genetic link between parent and offspring. The measuring of cortical bone is a way to determine a possible predisposition for osteoporosis. A scattergram will be used to demonstrate the correlation between parent and offspring.

**OBJECTIVES:** The Student will:

1. Make and record several metacarpal measurements from contact prints of x-ray pairs of parents and offspring;
2. Compute the cortical thickness of metacarpal bones; and
3. Construct and analyze a scattergram from the paired data (parent/offspring) of cortical thickness.

### VOCABULARY:

cortical bone: compact hard bone that gives the body strength

marrow: soft fleshy tissue in the hollow center of the large bones of the body

marrow cavity: hollow inlet in the bone filled with marrow

metacarpal: the long bones in the palm of the hand

radiogrammetry: recording information by using x-rays

scattergram: a two-dimensional graph consisting of points whose coordinates represent values of two variables under study

### MATERIALS AND EQUIPMENT:

x-rays of left hand from 3 pairs of parents and offspring (one set per group) - not included  
metric rulers, calculators, Lab Sheets G-4A and G-4B

### PREPARATION:

1. Duplicate Lab Sheet G-4A, one per student.
2. Read Lab Sheet G-4B to discuss with students.

### PROCEDURE:

1. Discuss location of metacarpal at the base of the index finger. The terms width and thickness are used interchangeably in this lesson.
2. Discuss how scattergrams are constructed, their value in interpreting special populations of data, and how they show trends (see Information Sheet G-4B).
3. Divide students into small groups.
4. Distribute Lab Sheet G-4A, graph paper, and x-ray sets.
5. Complete Lab Sheet G-4A.
6. Construct a scattergram based on the measurements from Lab Sheet G-4A.
7. Analyze the data recorded on the scattergram.

### EVALUATION:

1. Completion of Lab Sheet G-4A and scattergram.

NAME: \_\_\_\_\_

## X-RAY VISION

1. Use your metric ruler to locate the exact middle of the second metacarpal dividing the bone in half from top to bottom (on each of the x-rays you have obtained).

2. With the ruler, measure the total width of the second metacarpal bone on each x-ray:

Parent A: \_\_\_\_\_ mm

Child A: \_\_\_\_\_ mm

Parent B: \_\_\_\_\_ mm

Child B: \_\_\_\_\_ mm

Parent C: \_\_\_\_\_ mm

Child C: \_\_\_\_\_ mm

3. Now measure the marrow cavity, which is the grey region inside the metacarpal. Make sure that you measure at the same location on the bone, as with the last measurement.

Parent A: \_\_\_\_\_ mm

Child A: \_\_\_\_\_ mm

Parent B: \_\_\_\_\_ mm

Child B: \_\_\_\_\_ mm

Parent C: \_\_\_\_\_ mm

Child C: \_\_\_\_\_ mm

4. Calculate the cortical thickness here by subtracting total width minus marrow cavity.

Parent A's total width: \_\_\_\_\_

Child A's total width: \_\_\_\_\_

Parent A's marrow cavity: \_\_\_\_\_

Child A's marrow cavity: \_\_\_\_\_

Parent A's cortical thickness: \_\_\_\_\_

Child A's cortical thickness: \_\_\_\_\_

Parent B's total width: \_\_\_\_\_

Child B's total width: \_\_\_\_\_

Parent B's marrow cavity: \_\_\_\_\_

Child B's marrow cavity: \_\_\_\_\_

Parent B's cort. thickness: \_\_\_\_\_

Child B's cort. thickness: \_\_\_\_\_

Parent C's total width: \_\_\_\_\_

Child C's total width: \_\_\_\_\_

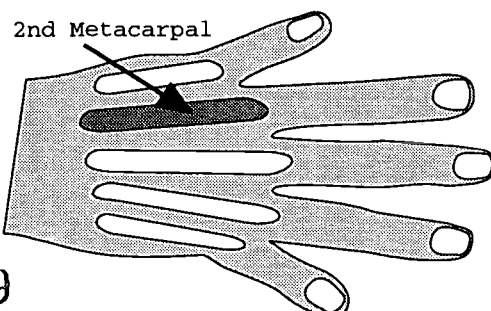
Parent C's marrow cavity: \_\_\_\_\_

Child C's marrow cavity: \_\_\_\_\_

Parent C's cort. thickness: \_\_\_\_\_

Child C's cort. thickness: \_\_\_\_\_

5. Record parents' and children's cortical thicknesses, calculated above, onto the following chart.



Plot the cortical thickness from Parent A,B,and C, and Child A,B, and C plus all cortical thicknesses from supplied data onto the scattergram Lab Sheet G-4B.

SUPPLIED DATA BELOW:

Parent Average	Child
1. (A)	(A)
2. (B)	(B)
3. (C)	(C)
4. 49.1	32.3
5. 54.5	40.4
6. 54.5	53.5
7. 56.2	38.4
8. 49.2	30.1
9. 42.8	29.7
10. 53.3	38.8
11. 48.3	38.3
12. 55.0	42.9
13. 52.0	37.7
14. 63.3	49.8
15. 39.6	30.9
16. 54.4	45.2
17. 60.6	43.2
18. 46.7	36.0
19. 52.6	41.4
20. 57.2	41.1
21. 50.1	34.2
22. 43.8	34.2
23. 57.3	41.5
24. 55.8	46.5

Make scattergram of gathered and supplied data: plot the cortical thickness of the paired data on graph paper. Plot the thicknesses of the parents on the X axis, and those of the children on the Y axis.

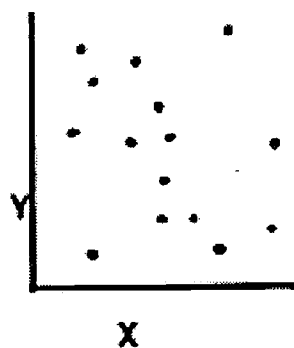
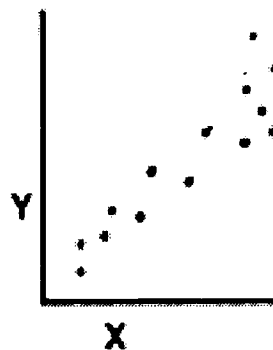
Examine your scattergram. What is your conclusion about cortical thicknesses of parents and children?

NAME: \_\_\_\_\_

**SCATTERGRAM REFERENCE**

Scattergrams are graphs made wherein two independent variables are plotted against each other. Because the variables are independent (not obviously related to each other), the plotted points may produce results which resemble buckshot hitting a piece of paper...the points are scattered. Sometimes, however, a strong relationship exists between the two variables; when this happens, a tight pattern will develop which tends to resemble a line.

For example, in sample A below, after the scattergram is constructed, there is no relationship between X and Y. In sample B there is a weak or general relationship between the X and Y variables. As the points along the X variable increase, so do most of the Y's. In sample C we see a strong relationship. The points plotted in sample C form a progression.

**SAMPLE A****SAMPLE B****SAMPLE C**

## LESSON FIVE: "From Your Point of View"

**TIME:** one 45-minute class



**OBJECTIVES:** The Student will:

1. Accurately measure height in centimeters;
2. Plot height on percentile charts;
3. Compare and contrast individual growth patterns to national norms and parent history; and
4. Predict personal growth patterns based on present information.

### VOCABULARY:

circumference: distance around

hand span: wrist crease to finger tip

hand spread: the greatest distance you can obtain by spreading your hand on the table and measuring from thumb to tip of little finger

length of reach: measurement from fingertip to fingertip when arms are spread out to the sides (equal to approximate height measurement)

long "cubit": distance from tip of elbow to the tip of finger

short "cubit": distance from tip of elbow to knuckle of clenched fist

### MATERIALS AND EQUIPMENT:

stadiometer or metric tape measure

national growth charts for boys and girls, G-5A and G-5B

### PREPARATION:

1. Obtain or duplicate appropriate growth charts for each student.
2. Make sure stadiometer or tape measure is properly mounted.
3. If available, collect parent height data in centimeters.

### PROCEDURE A:

1. Measure each student's height in centimeters.
2. Plot present height against present age on individual national growth charts. Remind students that they grow at different rates, and that height is only one indicator of growth and development.
3. Ask students to obtain personal growth data from home, showing previous measurements at younger ages (birth, one year, etc.) if available.
4. Plot previous measurements on chart and compare personal data to national norms.
5. Compare and contrast percentile information concerning height of parent(s) and student.
6. Use personal and parent information to predict maximal adult height. Find the average of parents' height and add 7 cm (approx. 2.27 in.) for males and subtract 7 cm for females.



For example: Mom = 165 cm      boy =  $182.5 + 7 = 189.5$  cm  
                   Dad = 200 cm      girl =  $182.5 - 7 = 175.5$  cm  
                   Total = 365 cm  
                   Average =  $365 \div 2 = 182.5$  cm

### PROCEDURE B:

This is helpful if you don't have "parents'" heights. It is a scientific method that uses bone measurements to calculate adult height. Remember, this is only an estimate.

7. Divide students into pairs.
8. Ask each student to measure his/her partner's arm from the shoulder joint to the bump on the near side of the elbow, then write down the number of inches here.

\_\_\_\_\_ This figure represents the length of the humerus, or upper arm bone.

9. Multiply this figure by 3.14(girls) \_\_\_\_\_ or by 2.97(boys) \_\_\_\_\_
10. Add 25.58(or 65 cm) (girls) \_\_\_\_\_ or 28.96(or 73.5 cm)(boys) \_\_\_\_\_
11. The final figure will give the adult height in inches ( or centimeters).

Optional:

12. If the anthropometry module is completed, this would be a good time to complete Spring measurements for "How Do I Measure Up?" Lab Sheet A-1A, provided at least three months have passed.
13. Do the Morning Stretch exercise on Lab Sheet G-5C.

### EVALUATION:

1. Completion of Lab Sheet G-5A or G-5B.

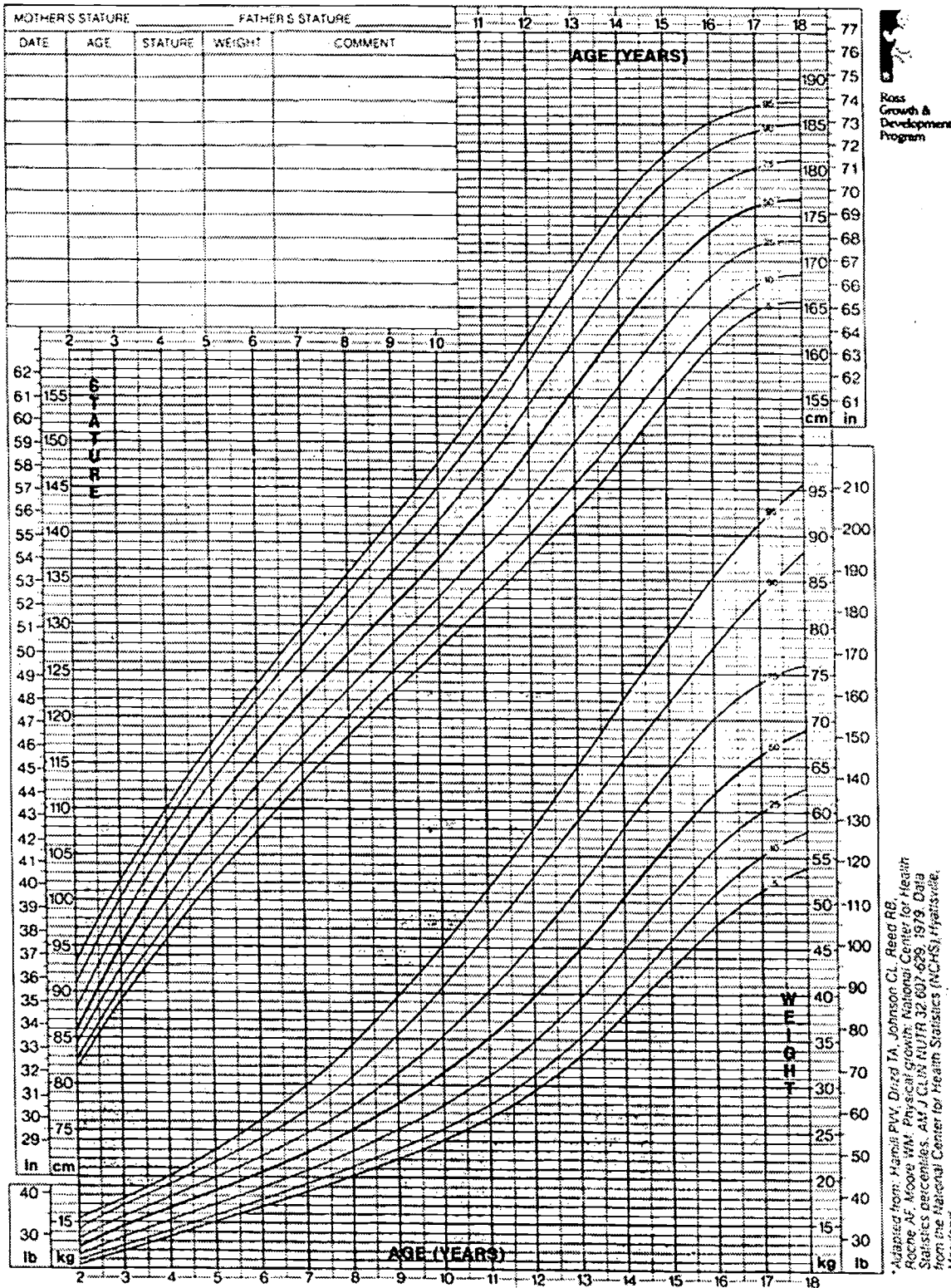
### RESOURCES:

1. family physician or pediatrician, school nurse, parents.

**BOYS: 2 TO 18 YEARS  
PHYSICAL GROWTH  
NCHS PERCENTILES\***

NAME \_\_\_\_\_

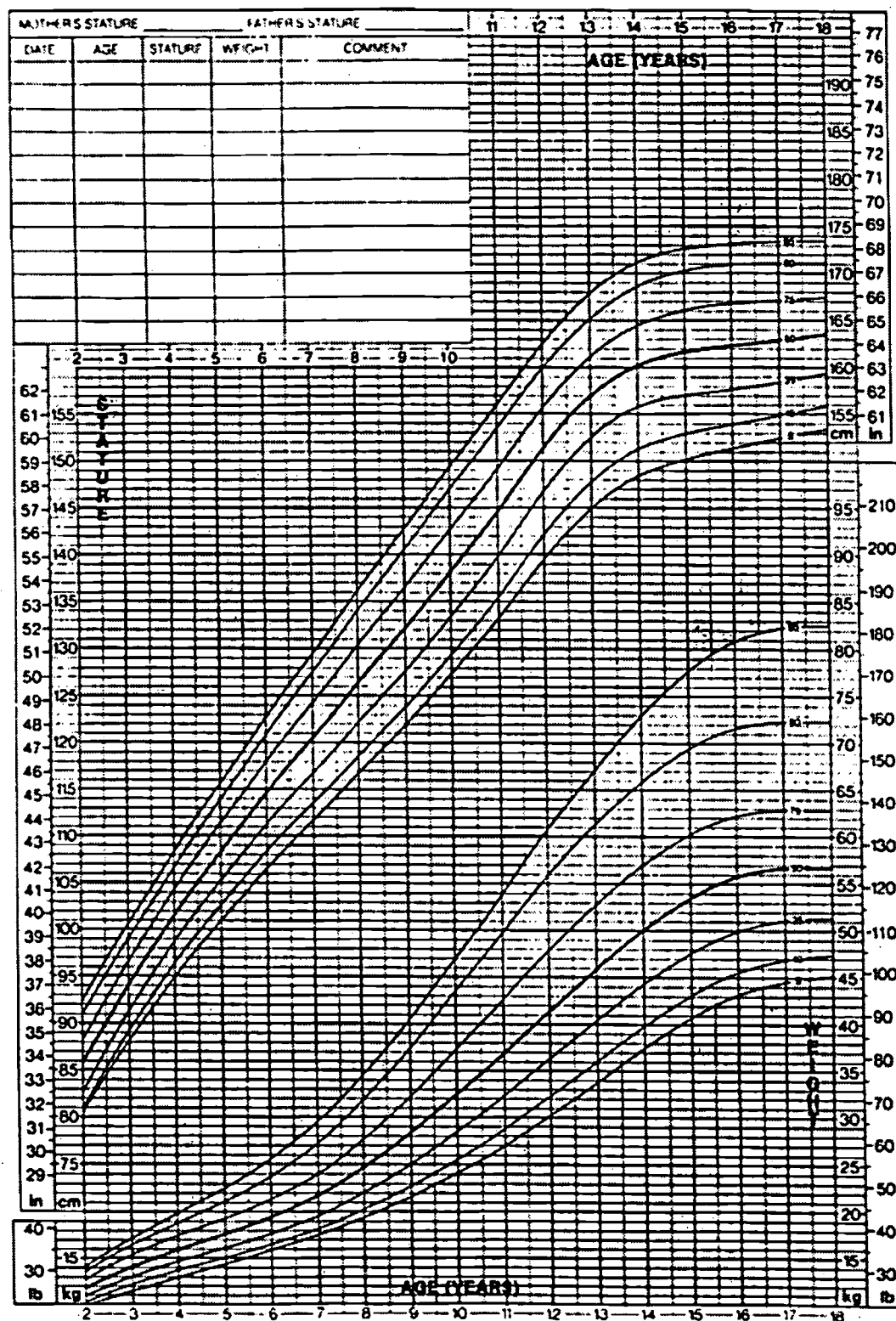
RECORD #



Adapted from: Hamis P.V., Dziad TA, Johnson C.L. Reed RG, Roche AF, Moore WM. Physical growth: National Center for Health Statistics percentiles. *AM J CLIN NUTR* 32:697-699, 1979. Data from the National Center for Health Statistics (NCHS), Hyattsville, Maryland

## NAME \_\_\_\_\_

RECORD #



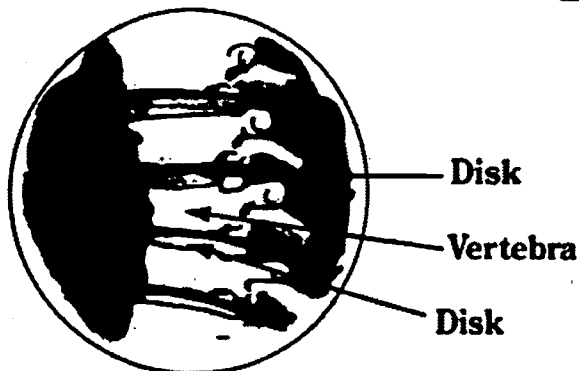
### Root Growth & Development Program

Adapted from Hamill PVV, Driz JA, Johnson CL, Reed RB, Blanche AJ, Moore WM. Physical growth: National Center for Health Statistics's percentiles. *AM J CLIN NUTR* 32:607-629, 1979. Data from the National Center for Health Statistics (NCHS) Hyattsville.

**Abstract**

## MORNING STRETCH

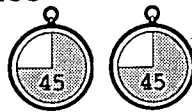
**A**t bedtime, ask a family member to hold a book flat on the top of your head and mark your height with a light pencil line on the wall. The next morning, when you first get up, measure again. You'll be taller! Overnight, the disks that separate the vertebrae in your spine swelled up with water that will be squeezed out during the day by gravity and physical exercise.



Source: The Bones Gamebook, pp. 84-85

## LESSON SIX: "Designer Genes"

**TIME:** two 45-minute classes



Note to Teacher: "...every human disease can be considered to occur as a result of an interaction between an individual's genetic makeup and the environment. In certain cases, however, the genetic component is so overwhelming that it expresses itself in a predictable manner without a requirement for extraordinary environmental challenges. Such diseases are termed genetic disorders." - Kurt J. Isselbacher, AB, MD

### **OBJECTIVES:** The Student will:

1. Discuss genetic diseases and disorders with his/her "family"; and
2. Gather information regarding genetic diseases and environmental components of genetic disorders.

### **VOCABULARY:**

disease: a condition of animals/plants or one of its parts that impairs the performance of a vital function

disorder: an abnormal physical or mental condition

environment: the circumstances, objects or conditions by which one is surrounded

genetics: the study of heredity; how traits are passed from one generation to another

### **MATERIALS AND EQUIPMENT:**

Lab Sheets G-6A and G-6B

### **PREPARATION:**

1. Duplicate Lab Sheet G-6A, one per student.
2. Become familiar with Information Sheet G-6B.

### **PROCEDURE:**

1. Distribute Lab Sheet G-6A.
2. Discuss the genetic influence and environmental factors that affect the expression of given diseases and disorders.
3. Outline a family plan for prevention of osteoporosis or another environmentally influenced disease.
4. Small groups or individual students will research, complete, and present a research paper or project on a disease of particular interest.
5. Students should discuss the information gathered from Lab Sheet G-6A with family members.

Optional:

6. The bottom portion of G-6A is to be detached, signed by parent(s), and returned to the teacher.

**EVALUATION:**

1. Completion of outline.

Optional:

2. Presentation of student research papers/projects.

**RESOURCES:**

1. local health agencies such as the Red Cross, Lung Association and Heart Association.

2. parents or guardians, family physicians, pediatricians.

NAME: \_\_\_\_\_

## DESIGNER GENES

The following medical conditions may have a genetic component because they tend to “run” in families. Which, if any, of these do you or your “blood” relatives have? Please ask your parents for help.

1. High blood pressure
2. Heart problems
3. Cancer
4. Sleep disorders
5. High cholesterol
6. Allergies
7. Sickle Cell Anemia
8. Tay-Sachs disease
9. Diabetes
10. Arthritis
11. Osteoporosis
12. Addictions
13. Other:

Please detach here and return bottom portion to school.

My child, (name) \_\_\_\_\_, and I have discussed this worksheet.

\_\_\_\_\_  
(signed by Parent/Guardian)



NAME: \_\_\_\_\_

Lab Sheet G-6B Page 1

# “DESIGNER GENES”

## Information Sheet

The following medical conditions may have a genetic component because they tend to “run” in families. Which, if any of these, do you or your “blood” relatives have? Please ask your parents for help.

1. **HIGH BLOOD PRESSURE** - HBP is diagnosed when one or both numbers of a blood pressure fraction (example 120/80 is normal) are elevated on several separate occasions and several days apart. It is likely inherited.
2. **HEART PROBLEMS** - coronary heart disease that narrows the coronary arteries, reducing the blood supply to the heart. This disease runs in families.
3. **CANCER** - a condition characterized by uncontrolled growth. Some cancers, including those of the breast and colon, occur among blood relatives at a higher than average rate. Scientists conclude that some people inherit a tendency to develop a certain type of cancer. Environmental elements, such as dietary habits and exposure to toxic substances, will put a person at higher risk for cancer.
4. **SLEEP DISORDERS** - abnormalities, such as insomnia or sleep apnea, that produce a range of disorders from a lack of sleep for an extensive period of time to an uncontrollable tendency to fall asleep. The predisposition for these disorders may be inherited.
5. **HIGH CHOLESTEROL** - a higher than normal concentration of cholesterol (a waxy lipid) in the blood. People may have high cholesterol levels if they have an abnormal gene (familial hypercholesterolemia) that prevents a full number of LDL receptors (a cellular molecule that controls the amount of cholesterol in the body) from forming.
6. **ALLERGIES** - body reactions that occur in persons who are sensitive to certain substances causing mild to severe symptoms. Heredity may be a factor.
7. **SICKLE CELL ANEMIA** - a hereditary blood disease. In the U.S. it occurs chiefly in blacks. This disease also affects people of Hispanic, Middle Eastern, and Mediterranean origins. Sickle Cell Anemia causes periodic conditions including severe pain and fever. In many cases, body organs such as bones, liver, lungs, and spleen are damaged. The damage may lead to strokes, kidney failure, severe infection, and sudden death.



8. **TAY-SACHS DISEASE** - a hereditary brain disorder that occurs chiefly among Jews of Eastern European ancestry. Tay-Sachs disease causes severe brain damage, enlargement of the head, convulsions, blindness, deafness, lack of energy, and eventual death. Symptoms begin to develop at about six months. Most children live only three to four years.
9. **DIABETES** - a disease in which the body cannot use sugar normally or pituitary glands function abnormally. It is common in some families. Some believe that the tendency is inherited for diabetes.
10. **ARTHRITIS** - any of more than 100 diseases of the joints. Characteristics are pain, stiffness, and swelling at the joints. Some forms are genetically linked, but susceptibility to the disease is all that can be inherited.
11. **OSTEOPOROSIS** - a bone disease that develops primarily after menopause in women and is characterized by a decrease in bone density. This disease includes both environmental and genetic factors.
12. **ADDICTIONS** - compulsive or repeated harmful behaviors that control an individual, such as smoking, alcohol, or drugs. Research indicates that addictions may have some hereditary as well as environmental components.

## RESOURCES FOR MODULE 5: GENETICS

### Strongly Recommended:

family physician or pediatrician, school nurse, parents.

Gutnik M, Genetics: Projects for Young Scientists, Franklin Watts Pub., NY, 1985. ISBN 0-053-15131-X.

local health agencies such as the Red Cross, Lung Association, and Heart Association.

### Other Resources:

Bornstein S, What Makes You What You Are, Julian Messner, NY, 1989. ISBN 0-671-63711-8.

Edelson E, Genetics and Heredity, Chelsea House Pub., NY, 1990. ISBN 0-7910-0018-4.

Ohio Health Promotion Network, Bureau of Health Promotion and Education, Ohio Department of Health, P.O. Box 118, Columbus, OH 43266-0118. (614) 644-7852. Various educational materials.

Stwertka E & A, Genetic Engineering, Franklin Watts Pub., NY, 1989. ISBN 0-531-10775-2.

"Who Are You?" AAY4337. 1995 Films for the Humanities and Sciences. P.O. Box 2053 Princeton, NJ, 08543. 1-800-257-5126. Fax # 609-275-1400.

## APPENDIX A:

### GLOSSARY OF TERMS

absorption: the process of taking in dietary minerals to build and maintain bone tissue

acetic acid: scientific name for the weak acid found in vinegar

activity: a description of what a person is doing, whether or not he/she is moving

adipose tissue: connective tissue in which fat is stored

albumin: water-soluble proteins that occur in blood plasma or serum, muscle, the whites of eggs, milk, other organic substances; normally not excreted in the urine

anabolic steroid: synthetic version of the male hormone testosterone

anorexia nervosa: an eating disorder involving a psychological loss of appetite and self-starvation; difficult to diagnose by urinalysis because the body compensates for lack of food

blood pressure: pressure exerted on the arterial walls

body density: ratio of the body's mass to its volume

bulimia: an eating disorder in which large quantities of food are eaten at one time (bingeing) and soon purged from the body by vomiting, use of laxatives, or other means

calcium: a soft white mineral substance which aids in building bones

calorie: the heat needed to raise one gram of water one degree Celsius

cardiac muscle: involuntary heart muscle; these muscles work constantly without tiring

carnivore: a meat-eating animal

characteristics: the unique or distinct traits that comprise an object or person

circumference: distance around

collagen: the connective tissue made of protein, found in bones

compound fracture (open): a fracture in which there is an external wound leading to the break of the bone

conclusion: a reasoned judgment based on a hypothesis

cortical bone: compact hard bone that gives the body strength

cycling: taking multiple doses of steroids over a specific period of time, stopping for a time and starting again

dehydration: an abnormal depletion of body fluids

demineralize: to remove the mineral matter from a substance

diabetes mellitus: a disorder characterized by inadequate secretion or utilization of insulin, excessive amounts of sugar in the blood and urine, thirst, hunger, and loss of weight

diastolic: pressure exerted by blood on the arterial walls when the heart is at rest (filled with blood)

disease: a condition of animals/plants or one of their parts that impairs the performance of a vital function

disorder: an abnormal physical or mental condition

dissection: the act of separating objects into pieces for scientific study

distal: away from the center of a body

diuretic: a substance which, when ingested, increases the output of urine

DNA: the genetic material in cells

dominant: when present, a trait that appears in offspring; expressed with an uppercase letter in a Punnett Square

eating disorder: a pronounced disturbance in the way someone eats

elasticity: the capacity of a strained body to recover its size and shape after deformation

energy: the capacity to do work

environment: the circumstances, objects, or conditions by which one is surrounded

excretion: useless or harmful material that is eliminated from the body

femur: the proximal bone of the hind or lower limb (thigh bone)

fissure: a crack extending from a surface into, but not through, a long bone

food pyramid: a graphic representation of a variety of foods used to get the nutrients that you need each day

gene: a portion of the genetic material that carries hereditary traits

gene pool: total of all genes in a given population

genetics: the study of heredity; how traits are passed from one generation to another

glucose: a simple sugar widely found in nature, normally not excreted in the urine

growth plate: the sensitive sites where bone growth occurs throughout the body

habitat: the place or type of site where a plant or animal lives

hand span: wrist crease to finger tip

hand spread: the greatest distance you can obtain by spreading your hand on the table and measuring from thumb to tip of little finger

herbivore: a plant-eating animal

homeostasis: a relatively stable state of equilibrium

horizontal: parallel to a baseline of horizon

hypothesis: an educated guess, based on gathered data to explain a phenomenon

ketone: a by-product of fat metabolism

kilocalorie (Kcal / food calorie): the heat needed to raise 1,000 grams (1 liter) of water one degree Celsius

lanugo: downy hair grown on the body to replace the insulation supplied by body fat

length of reach: measurement from fingertip to fingertip when arms are spread out to the sides

long "cubit": distance from tip of elbow to the tip of finger

marrow cavity: hollow inlet in the bone filled with marrow

marrow: soft fleshy tissue in the hollow center of the large bones of the body

mass: the amount of material an object or body contains

metacarpal: the long bones in the palm of the hand

national norm: an average on a national level

nutrients: chemical substances in food that nourish the body

occult blood: blood cells not seen by the naked eye, but present in the urine

omnivore: an animal that eats both plants and animals

opaque: not letting light through an object

osteoblast: cells that make new bone material by hardening the protein collagen with minerals

osteoclast: cells that dissolve bone material, releasing the minerals into the blood

osteoporosis: a medical condition resulting in porous bones that are easily fractured

ounce: a small unit of measure (16 oz. = 1 lb., 8 oz. = 1 cup)

percent body fat: the ratio of the body's fat mass to the body's total mass

percentile: a value on a scale of 1 to 100 that indicates the percent of a distribution that is equal to, or below it

pH: a measure that expresses both acidity and alkalinity on a scale whose values run from 0 to 14, with 7 representing neutrality; numbers from 0 to 7 increasing in acidity, and numbers 7 to 14 increasing in alkalinity

predator: an organism that attacks and eats prey

prey: an animal eaten by a predator

proximal: located toward the center of a body

pulse: the expansion and relaxation that can be felt in an artery each time the heart contracts and relaxes

Punnett Square: a way of determining potential genetic traits in offspring

radiogrammetry: recording information by using x-rays

recessive: when present, a trait that is masked unless it is pure; expressed in a lowercase letter in a Punnett Square

recovery rate: the time it takes the heart to return to its resting rate

resorption: a type of bone loss due to osteoclastic activity

resting heart rate: how fast the heart beats when a person is sitting still

risk factor: an attribute that increases a person's chance of contracting a certain disease or condition (e.g. smoking tobacco is a major risk factor for lung cancer)

scattergram: a two-dimensional graph consisting of points whose coordinates represent values of two variables under study

serving size: an arbitrary helping of food or drink

short "cubit": distance from tip of elbow to knuckle of clenched fist

short-term fasting: abstaining from food; may cause an elevated ketone level, increased specific gravity, and the appearance of albumin in the urine

simple fracture (closed): a fracture that does not produce an open wound in the skin

skinfold caliper: measuring instrument with two legs that can be adjusted to determine skinfold thickness

smooth muscle: involuntary muscle; muscles that contract and relax on their own

specific gravity: the ratio of the density of a substance to the density of pure water

stacking: using a combination of anabolic steroids, often in conjunction with other drugs

stress fracture (fatigue): a fracture attributed to the strain of prolonged running or other exercise

striated muscle: voluntary skeletal muscle; people control movement of these muscles

systolic: pressure exerted by blood on the arterial walls when the heart contracts (forcing blood out of the heart).

target heart rate: the ideal heart rate to be achieved during exercise

testosterone: the hormone which controls the development of masculine characteristics

translucent: transmits and diffuses light so that objects beyond cannot be seen clearly

transparent: transmits light so that objects beyond can be seen clearly

tricep: the muscle along the back of the upper arm

U.S. RDA's (Recommended Dietary Allowances): the amount of a vitamin, mineral, or nutrient that a person should get in their daily diet, according to the U.S. Food and Drug Administration

urine: liquid waste material that is secreted by the kidneys

vertical: perpendicular to the horizon

volume: cubic capacity

weight bearing exercise: an exercise that causes muscles to work against the force of gravity, such as stair climbing, running, or tennis

## APPENDIX B:

### GRAPHING AND GRAPH PAPER

A graph is a way to visually represent data. There are several types of graphs to use. The type of graph used depends on whether a comparison, a change, or a correlation will be shown.

#### Graphs on no axis:

Pie graph or circle graph - shows relationships between data using percentages as compared to the whole. This is considered a modification of a bar graph.

#### Graphs on two axes:

Bar graph - used to show a comparison between two or more examples using the x and y axis (independent and dependent variable).

Line graph - used to show a relationship between two examples as they change or to show change in a situation displayed on the x and y axis (independent and dependent variable).

Scattergram - used to show a correlation between two examples displayed on the x and y axes. (Both axes are independent variables and the outcome may or may not show a linear correlation.)

#### Parts of Graphs on Two Axes:

Title - tells what the graph is about

Label for y axis

Vertical or y axis or abscissa

Dependent variable gets plotted here

Increments - must be equal distances apart

Origin - usually zero (0,0), where the graph starts

Horizontal or x axis or ordinate

Independent variable gets plotted here

Label for x axis

**Other helpful information for graph construction:**

use a straight edge  
use a compass for pie or circle graphs  
in a bar graph, keep the bars equal width  
do not use different colors unless it is for a specific purpose  
center the title and all labels

**Information for pie or circle graph and bar graph:**

Number of right and left handed students  
right handed students - 20 ( $20 \div 25 = 80\%$ )  
left handed students - 5 ( $5 \div 25 = 20\%$ )  
total number of students - 25

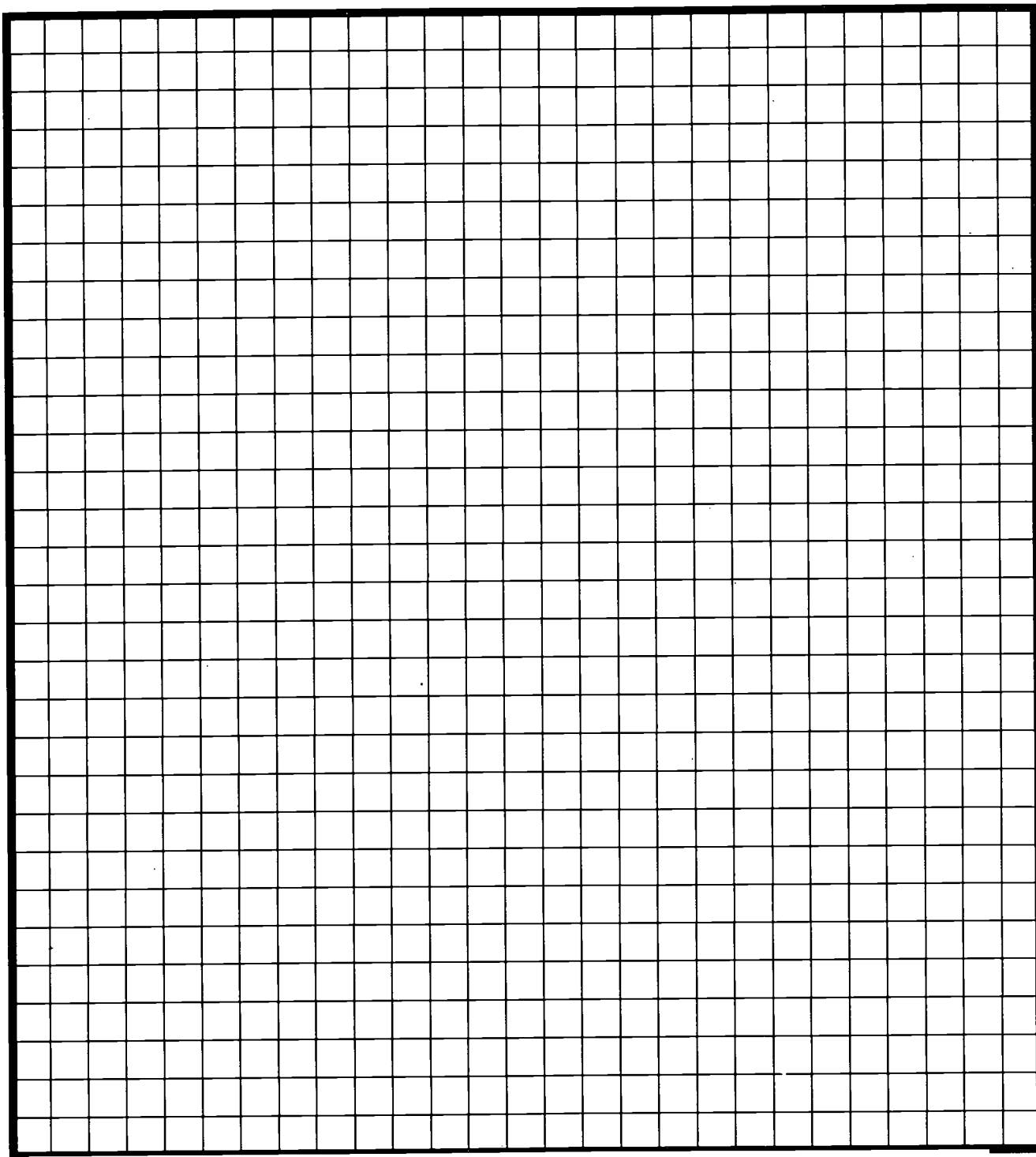
number of students - y axis - dependent variable  
right handed and left handed students - x axis - independent variable

**Information for line graph:**

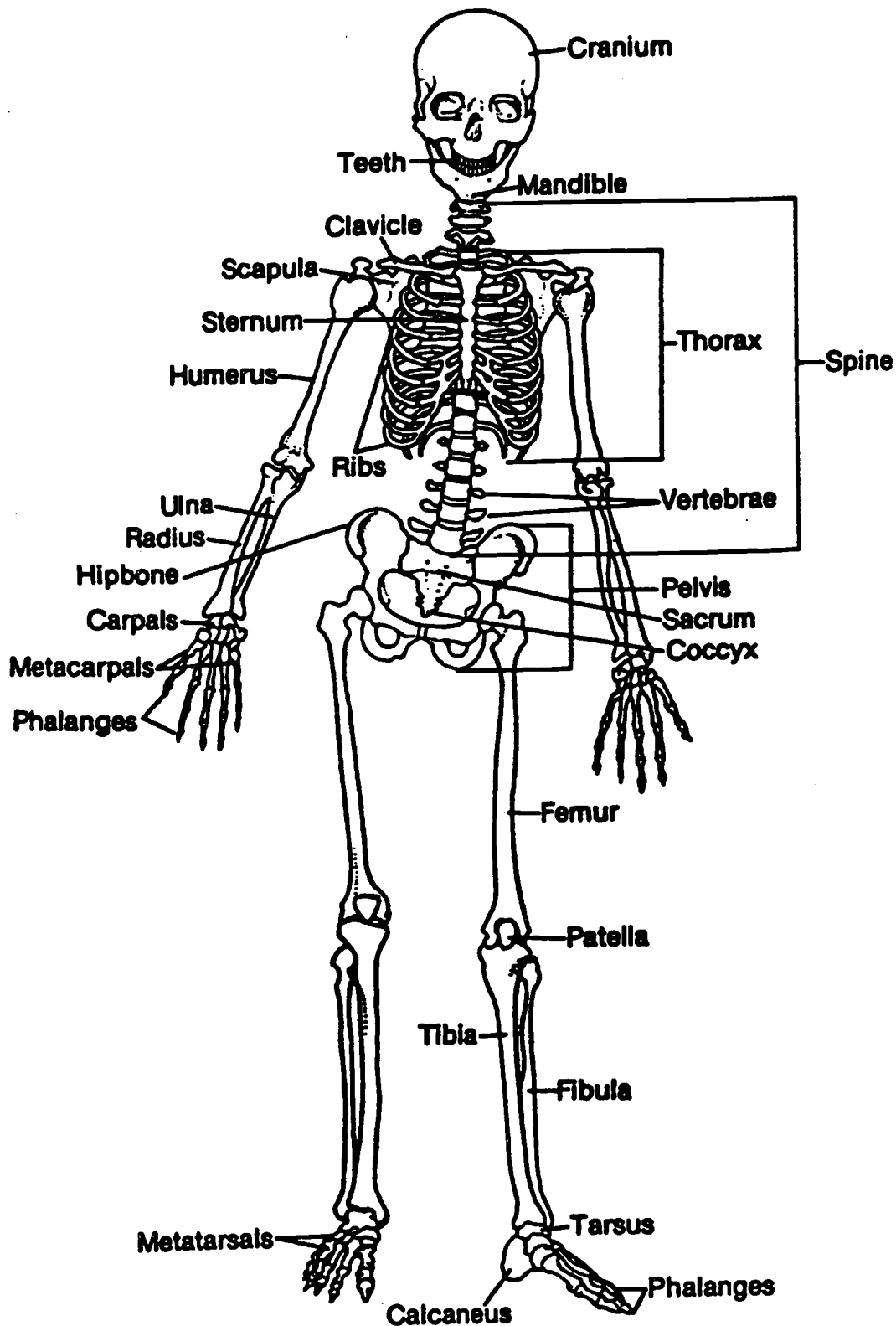
Casey's height in sixth grade:

Sept. - 139.0 cm  
Oct. - 139.6 cm  
Nov. - 141.0 cm  
Dec. - 141.2 cm  
Jan. - 141.9 cm  
Feb. - 142.2 cm  
Mar. - 142.6 cm  
Apr. - 143.1 cm  
May - 143.6 cm  
June - 144.0 cm





# APPENDIX C: DIAGRAM OF SKELETON WITH LABELS



## APPENDIX D:

### SCIENTIFIC METHOD

1. Ask a Question - what do you want to find out?
2. Gather Background Information - learn as much as possible about the topic from various media as well as from interviews.
3. Form a Hypothesis - an educated guess as to what you think the answer to your question from (1) is based on the information that you gathered in (2).
4. Do an Experiment or Test - a procedure designed to generate data and to determine whether the hypothesis (step 3) is correct.
5. Record the Results - what happened as the result of your experiment; usually in the form of statistics.
6. Write a Discussion - an explanation of why the results support or refute the hypothesis.
7. Draw a Conclusion - a determination of whether or not the hypothesis was correct, based on the data generated during the experiment (step 4).

## APPENDIX E: WELLNESS TRIVIA GAME

**TIME:** one class period

**OBJECTIVE:**

1. Demonstrate current knowledge of wellness terminology; and
2. Work cooperatively with team members.

**MATERIALS AND EQUIPMENT:**

skeleton puzzle pieces

question cards - questions typed on 3x5 note cards or copies on stiff paper cut to size.

**PREPARATION:**

1. Make copies of skeleton figure. The number of copies is dependent on number of groups that will be formed.
2. Cut the skeletons into puzzle pieces. The teacher can make as many puzzle pieces as they desire.
3. Make copies of game cards containing the questions and answers. One set of cards are needed for every two groups.

**PROCEDURE:**

1. Bone trivia can be used with large or small groups. The teacher may elect to divide the class into two groups with the teacher serving as the "Quiz Master" or the class can be divided into groups of three to five students. With smaller groups, a student can be appointed the "Quiz Master".
2. The "Quiz Master" will control the question cards and the skeletal puzzle pieces.

**3. GAME RULES**

- a. The game consists of two teams and the "Quiz Master".
- b. The "Quiz Master" may flip a coin to see which team gets the first question.
- c. The "Quiz Master" should shuffle the deck before the start of each game.
- d. The "Quiz Master" will select a card from the top of the deck and read the question to the first group.
- e. Group 1 has twenty seconds to provide an answer to the question. If group 1 does not answer the question within the allotted time or gives an incorrect answer, then group 2 would be given the opportunity to answer that specific question or can call for another question. ( In the event that the incorrectly answered question 1 was a true/false type question, group 2 would automatically be asked the next question.)

- f. The "Quiz Master" now selects a new card from the deck and asks a new question for group 2 to answer. The same rules will be followed as in part "e." In the event that group 2 failed to answer their question correctly or within the time limit, Group 1 would be given opportunity to answer or elect another question.
- g. When a question is answered correctly the group is entitled to a piece of the skeleton. The first group that has a skeleton completed with skull is declared the winner. The "Quiz Master" will withhold the skull to be the final piece of a completed skeleton.
- h. Teachers can construct other variations of the game. Additional questions can be easily added. Use your imagination!

## QUESTIONS

Q. True or False. The bones in your body are nonliving. A. False

Q. True or False. Red blood cells are formed within the marrow. A. True

Q. Name the major protein found in bone. A. Collagen

Q. Hardness of bone is because of phosphates and \_\_\_\_\_. A. Calcium

Q. What is the function of the skull? A. Protects the brain.

Q. What is the function of the teeth? A. Chew, tear, and grind food

Q. What is the common name of the patella bone? A. knee cap

Q. What is the common name of the scapula? A. Shoulder blade

Q. What is the scientific name given to your fingers? A. Phalanges

Q. What is the scientific name given to your toes? A. Phalanges

Q. What would be the effect of baking a chicken bone at extreme heat? A. Bone would become brittle.

Q. Which bone would you find in your arm- the radius or tibia? A. Radius

Q. True or False. The skull is a single bone. A. False

Q. True or False. The pelvis is a single bone. A. False

Q. Name the group of bones that form the wrist. A. Metacarpals

Q. Name the group of bones that form the ankle. A. Metatarsals

Q. Name the group of bones that make up the hand. A. Carpals

Q. Name the group of bones that make up the foot. A. Tarsals

Q. What is the common name for your clavicle? A. Collar bone

Q. What is the name of your jaw bone? A. Mandible

Q. Your forearm is made up of two bones. The \_\_\_\_ and \_\_\_\_\_. A. Ulna and radius.

Q. The portion of the leg below the knee is made up of two bones. The \_\_\_\_ and \_\_\_\_\_. A. Tibia and Fibula

## QUESTIONS

Q. Which group is most prone to having osteoporosis - men or women? A. Women

Q. A broken bone that heals will be stronger or weaker than before? A. Stronger

Q. Who typically has more body fat - men or women? A. Women

Q. Before puberty boys' and girls' body shapes are similar or different? A. Similar

Q. Osteoporosis causes bones to become stronger or weaker? A. Weaker

Q. Where would you find the sternum - Head, chest or back? A. Chest

Q. True or False. Your bones are fully formed at birth. A. False.

Q. Your cranium is the same as your \_\_\_\_\_. A. Skull

Q. According to the food pyramid, you should eat more fruit or meat? A. Fruit

Q. An eating disorder that involves self-starvation is called \_\_\_\_\_. A. Anorexia Nervosa

Q. What would be the effect of soaking a chicken bone in vinegar? A. The bone would become flexible.

Q. What is the probability of having a girl - 45%, 50%, or 60%? A. 50%

Q. True or false. Dissecting an owl pellet is a good way to find out what it ate. A. True

Q. True or false. There are no ill effects from using anabolic steroids. A. False

Q. A person with diabetes mellitus will/will not have sugar in the urine. A. Will

Q. A person with diabetes mellitus will have normal/high blood sugar. A. High

Q. Which bone would you find in your leg - the humerus or femur? A. Femur

Q. True or false. A brown-eyed couple could only have brown-eyed kids. A. False

Q. The pH of stomach contents would be - acid, alkaline or neutral? A. Acid

Q. A pH of 7 would be considered acid, alkaline or neutral? A. Neutral

Q. True or false. Hemophilia is a genetic disease. A. True

Q. A family has 2 boys. What is the chance of mom having another boy - 25%, 50% or 75%? A. 50%

## **APPENDIX F:**

### **STUDENT ASSESSMENT ACTIVITIES**

Because the authors feel strongly that the usual paper-and-pencil test probably would not be a good indicator of all levels of assessment, they chose to create individual and small group activities in which students can apply their skills toward problem-solving situations. - Ed.

#### **LEVELS OF ASSESSMENT FOR HUMAN GROWTH CURRICULUM**

##### **Level 4. Integration**

I am able to explain and support my healthy lifestyle.  
I create and test new strategies that investigate a specific problem.  
I will commit to affecting change in my environment.

##### **Level 3. Simulation**

I will model a healthy lifestyle.  
I apply appropriate problem-solving strategies.  
I can develop a plan for making healthy changes within my environment.

##### **Level 2. Application**

I choose to maintain a healthy lifestyle.  
I select appropriate strategies to solve a problem.  
I can select appropriate changes to make my environment more healthy.

##### **Level 1. Knowledge**

I know how to maintain a healthy lifestyle.  
I know some problem-solving strategies.  
I know of healthful changes that could be made in my environment.



# STUDENT ASSESSMENT ACTIVITIES

## MODULE 1: ANTHROPOMETRY

### Level 3: Simulation

You are working as an assistant to an anthropologist and a discovery has just been made of a partial skeleton approximately 200 years old. The skeletal parts you have received are the radius, ulna, and the hand bones. You have been asked to estimate what information you can determine about the whole skeleton from these bones.

OR

You and a friend are exploring a cave during a vacation. You discover some bones which appear to be from a human skeleton. Near the bones is a sword and an empty treasure chest. The bones found were arm bones (radius and ulna) and the hand bones. You have been asked to estimate what information you can determine about the whole skeleton from these bones.

You are not to concentrate on bone lengths (numbers), but compare proportions.

Suggestion: Lab partners should use their notes for this assessment.

AND

After having studied "Pinch An Inch" and "Squeeze It" lessons, your friend expresses being extremely upset with her percent body fat even though both of you have observed that her measurement falls within the normal range. Using what you know, what would you say to your friend to convince her that she is OK and should not use extreme measures to change her body fat?

### Level 2: Application

A RESEARCH PAPER IS TO BE COMPLETED AND SHARED WITH THE CLASS DEALING WITH ONE OF THE FOLLOWING TOPICS.

Research information in health magazines and current periodical literature (Time, Newsweek, American Health, etc.) on percent body fat and its relationship to overall health.

OR

Research forensic procedures used in identification of crime victims or scientists studying the skeletons of ancient cultures.

## MODULE 2: BONE CHEMISTRY

### Level 3: Simulation

In small groups, construct a femur. Using common materials and the information from this unit, make the structure as realistic as possible. Be sure to include the characteristics of strength and appearance, as well as display the internal structures.

OR

Make a femur of a humanoid and draw a picture of the species it came from. Various T.V. programs or movies featuring alien species could be used as examples.

### Level 2: Application

From references of various animal skeletons, decide upon your own categories for these animals. Keep in mind where the animals lived, what they ate, and how they interacted with their environment. Develop a way to present this data to the class.

(Teacher information - categories might include the following: mammals or non-mammals, predator or prey, land or sea, herbivore or carnivore or omnivore, etc.)

Reference for animal skeleton - Parker S, Skeleton, Eyewitness Books, Knopf Pub., NY, 1988.

OR

Design a lesson to be taught to a lower elementary grade level that explains the structure of bones. Explain why our bones are both strong and flexible. Include a game that demonstrates these ideas and involves all the children in physical activity.

## MODULE 3: NUTRITION

### Level 3: Simulation

(THE STUDENT PLAYS THE ROLE OF THE ADVICE COLUMNIST AND RESPONDS TO THE FOLLOWING ARTICLE.)

Letter to the columnist: "I am a young girl who is overweight and do not want to go on another diet. What advice could you give me to help balance my weight and my health? Please reply soon!!! Signed, Help Me."

OR

You have just started an advertising company, but new federal laws say that all package labels must be 100% truthful. Your first assignment is to design a new package for your favorite snack food. (This is a take home exam.)

OR

(THE STUDENTS WORK IN SMALL GROUPS.) You are acting as medical interns who have been given a patient file (the teacher shall generate these files). Your duty is to diagnose the problem from the file and develop a possible plan to help the patient. You have 30 minutes to complete this task and orally present your findings and conclusions to the panel of doctors (the class). (Optional: the students may submit their plan as a written exam.)

### Level 2: Application

(The students are given the following situation for completion as an essay.) You are hired as a helper in a third grade summer camp. These campers usually eat whatever they want while at home. You want to be a positive role model to them in making nutritional decisions. Your job is to plan a well-balanced, one day menu for the campers. You may use any format that you desire. Also, make suggestions about what you will do to motivate campers to eat your chosen menu.

OR

The "Good for You" Cafe: Plan a luncheon for your family or another class. Everything prepared and served must be nutritious and appealing. Use the information you have learned in the nutrition module. Then prepare the food and invite parents or another class to come to lunch at your cafe.

## MODULE 4: EXERCISE PHYSIOLOGY

### Level 3: Simulation

We challenge you to commit yourself to an exercise or physical activity, such as swimming, jumping rope, walking, running, or other aerobic exercise for an initial two-week period. During this time, record in a log your resting heart rate before you begin, heart rate when you complete the activity, and heart rate five minutes after stopping the activity.

What do you predict will happen to your heart rate and your energy level during the two week challenge?

Compare your prediction hypothesis with your actual findings. Share your results with your class or a friend.

**\*\*Note:** Please consult your parents and a physician before beginning this exercise program.

OR

You were cut from the varsity team this year, but your goal is to make the team next year. All of your friends are on the team and it is important for you to be included. List all of your possible options, both positive and negative, that would allow you to become a member of the team.

For all the possible options you have written, list the best solution for you and explain the reasons for your chosen plan.

OR

You have been asked by your physical education coordinator to help your class train for the President's Physical Fitness Test. Design a plan using a variety of training activities to improve speed, endurance, and strength over a four-week period. The goal is to have all members of the class pass the President's Physical Fitness Test. (Consult your physical education teacher for guidance.)

## MODULE 5: GENETICS

### Level 3: Simulation

Why might an employer want an individual to submit to genetic screening? Why might an individual be reluctant to do so?

Formulate positions and debate the issue of whether or not mandatory testing of workers for genetic background should be legal or illegal.

Reference: Video of Larry King Live Interview from June 30, 1993. Topic: Criminal on death row found innocent due to DNA testing.

Time Magazine article on DNA testing.

### Level 2: Application

Research one disease that is genetically inherited. Include in your research the possibility of passing the disease on to your offspring. Be sure to research whether the disorder is displayed or carried by one gender; also include if it is more commonly expressed in a particular race or ethnic group.

### REPORT YOUR FINDINGS IN ONE OR MORE OF THE FOLLOWING WAYS:

1. Write an editorial to a local newspaper explaining why more money and time should be spent helping people with this disease.
2. Write a script to a T.V. or radio commercial highlighting the reason why more money and time needs to be devoted to this disease. (Create your own video.)
3. Create your own pamphlet or brochure which explains your disease and demonstrates the need for additional funding.

MARCH OF DIMES IS A GOOD RESOURCE FOR GENETICALLY LINKED DISEASES.

OR

You are given the opportunity to select a mate to produce offspring. Your partner does not have to be anyone you know personally. Bring to class pictures of your chosen mate. Your picture should include at least four physical characteristics that you want in your offspring. List all the possible combinations for each of the four traits you have selected.

Share your offspring findings with the class. Use a Punnett Square and draw a picture of the possible offspring.

**APPENDIX G:**  
**PRE- AND POST- SURVEY**

Student Name: \_\_\_\_\_ Grade: \_\_\_\_\_

Circle the best answer for each question.

1. The distance around something is called the \_\_\_\_\_.

- a. measurement
- b. centimeter
- c. circumference
- d. diameter

2. An "educated guess" is called a \_\_\_\_\_.

- a. hypothesis
- b. conclusion
- c. comparison
- d. percentage

3. A mathematical mean is \_\_\_\_\_.

- a. grading on a curve
- b. an independent variable
- c. the answer to a multiplication problem
- d. an average

4. In general, who reaches their adult height first?

- a. boys
- b. girls
- c. boys and girls are about the same
- d. it depends on the parents' height

5. In general, who has the lower percentage of body fat at age 15?

- a. girls
- b. boys
- c. boys and girls are about the same
- d. it depends on bone density

6. Bones are made mostly of \_\_\_\_\_.

- a. chalk
- b. ivory
- c. silicon
- d. calcium

7. As you get older, your bones get \_\_\_\_\_.  
a. more elastic  
b. more brittle  
c. harder  
d. softer
8. What things are important for bone density?  
a. milk, cheese, and ice cream  
b. exercise and sleep  
c. diet, heredity, and exercise  
d. heredity and genes
9. The two most common sites of fractures caused by osteoporosis are \_\_\_\_\_.  
a. fingers and toes  
b. ribs and neck  
c. back and hips  
d. elbows and knees
10. When a bone breaks the \_\_\_\_\_ cells help to repair it.  
a. osteoblast and osteoclast  
b. spongy and hard  
c. osteoid and blastoid  
d. trabecular and cortical
11. According to the food pyramid, you should eat the most servings of \_\_\_\_\_.  
a. fruits and vegetables  
b. meat, fish, and poultry  
c. grain, cereal, and bread  
d. fat and oil
12. The \_\_\_\_\_ food group contains the most calcium per food item.  
a. Grain, cereal, and bread  
b. Milk, yogurt, and cheese  
c. Vegetable  
d. Fruit
13. If you eat a variety of healthy food, you will \_\_\_\_\_.  
a. Live longer  
b. Be slim  
c. Never get osteoporosis  
d. None of the above

14. If you spend more calories (energy) than you take in, you will \_\_\_\_\_.  
a. Build strong bones  
b. Gain weight  
c. Lose weight  
d. Stay the same weight
15. You should eat 6 to 11 servings each day from the \_\_\_\_\_ food group.  
a. Bread, cereal, rice, and pasta  
b. Meat, poultry, fish, dry beans, eggs, and nuts  
c. Milk, yogurt, and cheese  
d. Vegetable
16. Regular exercise \_\_\_\_\_ bone density.  
a. increases  
b. decreases  
c. has no effect on  
d. avoids
17. With regular exercise, there is a change in \_\_\_\_\_.  
a. respiration  
b. blood pressure  
c. heart rate  
d. all of the above
18. Two types of exercise are \_\_\_\_\_ and \_\_\_\_\_.  
a. aerobic and anabolic  
b. aerobic and anaerobic  
c. walking and standing  
d. hobbies and sports
19. The best rate for your heart to beat when you exercise is called the \_\_\_\_\_ heart rate.  
a. Resting  
b. Recovery  
c. Target  
d. Maximum
20. A urine test strip will not test for \_\_\_\_\_.  
a. Glucose  
b. Calories  
c. Protein  
d. Blood



21. Genetics is the study of \_\_\_\_\_.  
a. rocks and minerals  
b. osteoporosis  
c. electricity  
d. heredity
22. A trait that will show up more often than another is called \_\_\_\_\_.  
a. heterozygous  
b. allele  
c. dominant  
d. recessive
23. Curly hair is a \_\_\_\_\_ trait.  
a. heterozygous  
b. allele  
c. dominant  
d. recessive
24. The \_\_\_\_\_ trait is expressed as a lowercase (small) letter in a Punnett Square.  
a. Dominant  
b. Recessive  
c. Gene  
d. Allele
25. If your father has hybrid brown eyes and your mother has blue eyes, your chances of having blue eyes are \_\_\_\_\_ percent.  
a. 0%  
b. 25%  
c. 50%  
d. 75%

For Teachers: Answers to the Human Growth Pre- and Post-test

Module 1

1. C
2. A
3. D
4. B
5. B

Module 2

6. D
7. B
8. C
9. C
10. A

Module 3

11. C
12. B
13. D
14. C
15. A

Module 4

16. A
17. D
18. B
19. C
20. B

Module 5

21. D
22. C
23. D
24. B
25. C

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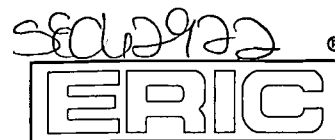
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